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PERSONALITY AND SPELLING ABILITY

BY

JACK A. HOLMES

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FOREWORD

Research on the nature of spelling ability and its possible relation to personality factors has been fragmentary and inconclusive. Investigators have suggested the existence of such a relationship, but have been none too certain concerning its character or its extent.

In this monograph, Dr. Jack A. Holmes reports an unusually careful and penetrating study of the relationship in question. Using more than 1,500 university juniors and seniors in a series of samples, he administered two tests of spelling ability and, initially, three well-known personality inventories of the self-analysis type. By a method of successive-sample analyses, the total of 1,018 items in the personality inventories was winnowed down to those which consistently discriminated between the "best" and "worst" spellers. In both sexes the best spellers were found to exhibit attributes which bore a certain similarity to the syndrome of "Willing Obedience" found by Sanford in children.

As predicted, Dr. Holmes finds that personality factors account for only a small amount of the total variance in spelling ability. It is, of course, the psychological significance of this statistically "small amount" of the total variance that makes this study interesting to serious students of school learning and personality theory. To explain his experimental findings, Dr. Holmes sets up a hypothetical construct, namely, mobilizers, and this brings psychology face to face with a seldom recognized, but nevertheless, basic and theoretically important question: "What are the dynamic elements in an individual that control the process by which his appropriate subskills (which underlie, or go to make up, an academic ability) are subconsciously mustered and brought into focus on the task at hand?"

William A. Brownell
Dean of the School of Education

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That part of this monograph which relates spelling ability to the personality subscales was summarized in a paper which was read at the Annual Meeting of the American Psychological Association in San Francisco in 1955. Further, that part which relates the results of the successive item analyses to spelling ability was summarized in an invited address given at a symposium before the same organization at its Cincinnati meeting in 1959.

The study was financed through Faculty Research Funds, School of Education, University of California.

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PERSONALITY AND SPELLING ABILITY

BY

JACK A. HOLMES

I. INTRODUCTION

The Problem

The purpose of this study is to discover the relationship, if any, that spelling ability at the college level bears to thirty-three personality traits which are purported to be assessed on the subscales of three well-known and widely used inventories.[1]

The Literature and Rationale

The rationale behind the present search for personality traits which might be related to spelling ability stems from several sources.

Phelan (26) factor-analyzed a battery of nineteen tests measuring visual perception, cognition, rote and logical memory, reading, and spelling, which had been administered to 460 children in grades five and six. She used Moore's extension of the Spearman two-factor method but was not able to isolate a general factor. In regard to spelling ability, her analysis indicated that:

1.97 per cent of the variance in spelling was due to variance in rote memory for words and letters;
39.20 per cent of the variance in spelling was due to variance in cognition;
10.07 per cent of the variance in spelling was due to variance in visual perception for words;
48.76 per cent of the variance in spelling was due to variance arising in other factors not tested for in her study.

Wishing to locate the sources which could account for the 48.76 per cent of the variance in spelling ability which Phelan's study failed to find, Holmes (15) sought to establish a relationship between ability to spell, ability to handle phonetic associations, and the factors involved in auditory images. Using a battery composed of a 5-choice multiple-choice type of spelling test, a phonetic association test, and eight subtests of an improved version of the Kwalwasser-Dykema Music Test (14) on a group of 227 high school students, he was able to show that:

[1] In order to be sure that per cent contributions in the variance of spelling ability which may be accounted for by personality factors are not, in fact, better accounted for by intelligence, a test of linguistic intelligence is also included in this study.

48.4 per cent of the variance in spelling was due to variance in phonetic associations;

5.5 per cent of the variance in spelling was due to variance in tonal movement; and

46.1 per cent of the variance in spelling was due to variance arising from other factors not assessed in the study.

Pursuing the search at a deeper level, however, he found by a substrata-factor analysis[3] that 13.5 per cent of the variance in phonetic association itself could be attributed to tonal movement, pitch, and intensity.

Likewise, Holmes (15) was able to show a relationship at the college level between the elements of auditory images and spelling ability. The battery of tests used was composed of two different types of spelling tests, the quantitative and linguistic subscales of the American Council on Education Psychological Examination for College Freshmen (ACE), a phonetic association test, and six subscales of the Seashore Test of Musical Talents..

Using a dictation–write-in type of spelling test as the criterion, analysis of the scores made by the first sample of 91 university students indicated that:

64.3 per cent of the variance of a dictation–write-in type of spelling test could be accounted for by the variance in a 5-choice multiple-choice type of spelling test;

5.0 per cent of the variance of a dictation–write-in type of spelling test could be accounted for by the variance in tonal memory;

3.1 per cent of the variance in a dictation–write-in type of spelling test could be accounted for by the variance in pitch; and

27.6 per cent of the variance in a diction–write-in type of spelling test could not be accounted for by the variables used in the study.

On a second sample of 102 university students, using a multiple-choice type of spelling test as criterion, Holmes (15) also found that:

32.5 per cent of the variance of a 5-choice multiple-choice type of spelling test could be accounted for by phonetic associations;

13.5 per cent of the variance could be accounted for by the linguistic-type of intelligence as measured on the American Council on Education Psychological Examination for College Freshmen (ACE); and 54.0 per cent of the variance could *not* be accounted for by the variables used.

Since these findings (15, 26) are fragmentary and do not resolve the problem of the specific sources of variance, Holmes set up a broad

[3] See bibliographical reference 13 for description of the substrata-factor analysis technique.

working hypothesis of the subabilities that might be expected to underlie spelling ability. For this, he made use of a diagram similar to that presented in figure 1.

In figure 1, kinesthetic factors, personality traits, and a substrata organizing factor specific to spelling are enclosed in parentheses. These parenthetical enclosures are used to suggest that these areas are par-

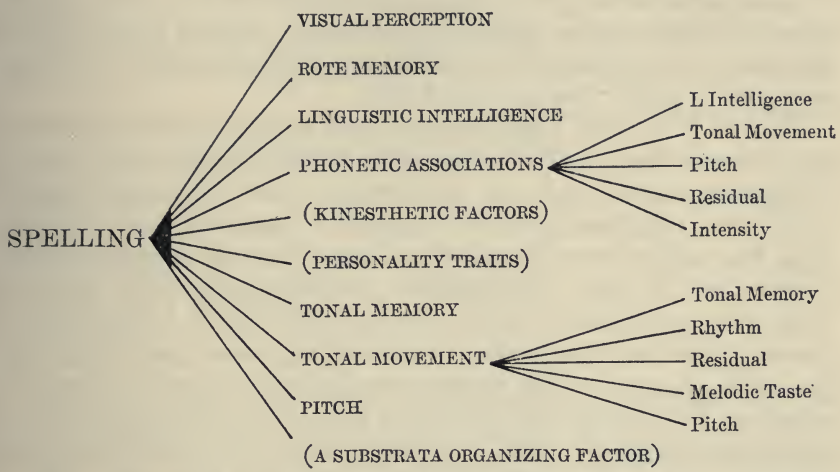

Fig. 1. Diagrammatic conceptualization for a working hypothesis of the subabilities which underlie spelling ability. Two sets of five subabilities each are shown in the right half of the figure. In each case the factors indicated are known to support, or partly account for, the variance of phonetic associations and tonal movement, respectively.

ticularly in need of further study; the other elements listed actually have been experimentally verified (15, 26) albeit at different levels and using different types of spelling criteria.[3]

Upon what evidence, we may ask, do we base the hypothesis that spelling ability is related to certain personality traits? Russell's (30) recent review of the literature, "Interrelationships of the Language Arts and Personality," cites not a single experimental study relating personality variables to spelling ability. However, he concludes one section of his review with the statement: "That spelling difficulties may be related to emotional difficulties has been suggested by Schonell (32), by Russell (29), and by Spache (34)." Kyte (21) also has made this suggestion.

An extensive combing of the literature before Russell's (30) 1953 review indicated that no investigator had come to grips with this problem at the college level. The search did reveal, however, that it had been given some attention at the elementary school level.

[3] The hazards inherent in gathering subtests from samples derived at different levels using somewhat different expressions of the criteria, spelling ability, are readily acknowledged.

Killgallon (20), using the Brown Personality Inventory which purports to assess adjustment in the areas of home, physical symptoms, irritability, school, and insecurity, could not find a significant relation between these personality traits and spelling ability for the 211 fourth-grade children in her sample.

Martin (23), using the California Test of Personality which purports to assess adjustment in the areas of self adjustment and social adjustment, likewise found no statistically significant relation between these personality traits and spelling ability for his total number of 48 boys and girls in grades four, five, and six.

Sanford *et al.* (31), using the very small number of 21 boys and 24 girls ranging from five to fourteen years old at the beginning of his investigation, carried out a very intensive three-year study which sought to establish relationships between physique, personality, and scholarship. The children were measured and rated every six months by their teachers and by three psychologists. An interviewer visited the parents, and a physician regularly examined the subjects. In addition to school grades and standardized tests, activity scores were obtained. Murray's press-need-thema theory was the basic theoretical frame of reference for making the personality ratings. Freud's theory of development was related to the increase in control, conscientiousness, and criticalness which the child displayed as he grew older.

A syndrome analysis by Sanford *et al.* (31) revealed five personality constellations or patterns which must be reviewed briefly as a basis for understanding how some of these constellations might be related to spelling ability. The personality constellations found are:

1. *The structured personality:* conscientious effort, orderly production, counteractive endocathection, self-sufficiency, guilt and remorse, and willing obedience syndromes are intercorrelated. Syndrome focuses attention on two hypothetical constructs: ego strength or structuration, and superego or internalized moral forces.

2. *The active and inactive; self-expressive or placid immobile personality:* lively self-expression and colorful intellectual self-expression—subject is playful and talkative or original and productive; undisciplined achievement and activity serves self-forwarding needs; subject asserts himself to attain positive satisfactions; goal is defensive—subject protects himself by taking the offensive (other syndromes have positive goals).

3. *The timid personality:* avoids threatening situations; remains silent in face of actual danger, anxious emotional expressiveness and timid dependence. The timid withdrawal syndromes suggest underlying feeling of inadequacy. In timid dependence succorance is not suppressed but kept alive by a certain amount of affection.

4. *The social being:* good fellowship, willing obedience, and social feeling.

5. *The sensation creator and the sensation seeker:* desire for sensory impressions seems to be underlying factor; however, although the sensitive imaginative creator

has the same tendencies toward excitement, sensuality, and bodily sensation as the sensation seeker, and again although both are subjective, human, and emotional in outlook, it is in the former only that this is carried into intellectual and artistic creativity and creates within the self means for sensuous enjoyment, whereas the latter take their pleasure directly from the environment (31, pp. 559–569).

Although Sanford *et al.* (31) report many correlations, only those pertinent to the present investigation are listed in table 1.

TABLE 1

COEFFICIENTS OF CORRELATION FOUND BY SANFORD ET AL., BETWEEN SPELLING ABILITY AND CERTAIN PERSONALITY TRAITS
(N = 28 to 45)

Personality traits correlated with spelling ability	r
Willing obedience	+.30
Social feeling	−.32
Good fellowship	−.48
Sensation syndrome	−.54
Sensative imaginative creator	−.06
Timid child	−.29

Perhaps insight into the suggested dynamics of the personality patterns and their relation to one another and to success in school subjects might best be gained by reviewing those aspects of the conclusions formulated by Adkins and Sanford.

Despite their negative correlations with Mental Age, the social syndromes tend to be significantly related to several intellectual and school ability patterns, most notably with general productivity (r's = .26 to .41) and art grades (r's = .33 to .52), syndromes in which expressiveness is an important factor. Willing Obedience correlates positively (r = .30) with spelling and handwriting, while Social Feeling and Good Fellowship correlate negatively, −.32 and −.48, with this school pattern. Thus Willing Obedience, involving as it does a need to avoid blame, seems to favor a painstaking approach, but children high on Good Fellowship or Social Feeling are probably too distractible (socially) to do well in subjects which require carefulness and attention to detail (31, p. 560).

The differences between Sensation and Sensitive Imaginative Creation stand out when we consider these syndromes in relation to school abilities. Sensitive Imaginative Creation is associated with generally good work in school—it correlates .59 with excellence of grades in all school subjects and positively, to a degree greater than .25, with all the patterns of specific abilities except spelling and handwriting (r = −.06). Sensation, on the other hand, correlates −.22 with general excellence of school grades, and around .00 with most patterns of specific abilities; negative correlations are in the majority, however, a correlation of −.54 with spelling and handwriting being especially noteworthy (31, p. 569).

This study by Sanford *et al.* is commendably replete with exciting hypotheses and clinical insights. It is regrettable that they did not use

a sample representative of the public schools, and it is likewise unfortunate that, excluding the 12 five-year-olds in the sample of 51, they obtained data from only 2 boys and 2 girls in each age group from six to fourteen years. Consequently the findings have a high probability of being relatively unstable; nevertheless, many seem to be logical and to agree in part with other psychological knowledge. All of them certainly form provocative hypotheses for further research.

A more recent study by Jensen and Insel (16), "Transfer Effects in Spelling," revealed that high school students show improvement in their ability to spell a certain set of words even when interpolated experience between pre- and post-test directed their attention to these words incorrectly spelled! Perhaps more closely related to the present study is the fact that they also found that there was no relation between the students' scores on the F-scale (Authoritarian Personality) and their ability to change their spelling scores from pre- to post-tests. The writers conclude, therefore, that there is no relation between rigidity in personality and ability to make a change in spelling score.

A study that bears relation to the present investigation was made by Doris Caldwell. Under the direction of Holmes, Caldwell (4) investigated the relationship between spelling ability and self estimates of ability to spell correctly. The whole problem is related to level-of-aspiration and the specificity or generality of self-evaluative behavior in the level-of-aspiration situation. In reviewing the literature, she concluded that, though conflicting evidence appeared, correlation studies tended to support the existence of generality. The greater the ego involvement, the greater the increase in the generality. Using 153 upper division and graduate students from an educational psychology class at the University of California as subjects, she gave a 45-item multiple-choice spelling test and also had the students indicate whether they felt their selected choice was correct, probably correct, pure guess, probably wrong, or wrong. Caldwell scored each paper separately for spelling, judgment, number and percentage of overestimations, and number and percentage of underestimations.

Two of the most significant findings which Caldwell's analysis brought out are that spelling ability and correct judgments about spelling are positively and significantly related ($r = +.62$), and that though the correlation between spelling and proportional overestimation is negligible, the correlation between spelling and underestimation is $-.54$. Since in relation to good spellers, poor spellers show less tendency to overestimate and a much greater tendency to underestimate their ability to spell a word correctly, Caldwell believed she was justified in concluding that "previous failure-experiences tend to be asso-

ciated with lowered self-estimation, . . . [there is] a positive association between failure and behavior indicative of inferiority feelings in which failure has been experienced" (4, p. 36). In other words, *poor spellers seem to have a slight feeling of inferiority in the specific area of spelling.*

Discussion

SETTING UP RATIONALE FOR EXPERIMENTAL DESIGN

If allowance is made for overlapping among the variables reported in the studies of Phelan (26) and Holmes (15), it is, perhaps, not unreasonable to assume that rote memory, cognition, visual perception, phonetic association, tonal movement, tonal memory, pitch, and linguistic intelligence could together account for an estimated 80 per cent of the variance reflecting individual differences in spelling ability.

If we consider the positive findings of Sanford *et al.* (31) and Caldwell (4) and the negative findings of Killgallon (20) and Jensen and Insel (16), it is obvious that the present investigation is a search for personality factors which, if found at all, can make only small independent contributions to variance in spelling ability. Further, the elusive nature of such personality factors, as is indicated by the inconsistent findings above, suggests the use of an experimental design that would

1. Guard against the premature loss of scales or items in the *initial* phases of the study, and also would

2. Guard against including in the *final* set any scales or items selected on the basis of chance alone.

To put it in statistical terms, an experimental design is needed that will be initially liberal enough to assure with practical certainty against the probability of committing a type II error (i.e., that of accepting a null hypothesis when in fact the hypothesis was false) because such an error would result in a premature loss of scales or items. Although sample sizes are not entirely under control of the experimenter, it is possible to preclude an excessive number of type II errors from occurring in the initial item analyses by sagaciously manipulating the level of significance. It follows, however, that when we accept a liberal level of significance to avoid a type II error, we tend to increase the chances of committing a type I error (i.e., that of rejecting a null hypothesis when in fact the hypothesis was true). Hence, it is important that the experimental design should systematically become more and more conservative in the level of significance acceptable as the separate phases of the initial experiment are partly replicated in the successive cross validations of the study. In this way it is hoped that the end

results will strike a sensible balance between the necessity of not making a type II error in the initial phases and of not committing a type I error in the final phase of the experiment. Specifically, then, the experimental design is governed by the following rationale: "all" errors of type I caused by the use of a too liberal level of significance in the initial phases of the study will be systematically caught and rectified by using a more conservative level in cross validations.

The reason it is imperative that a type II error must be cautiously guarded against, judging from the literature, is that it is highly improbable that more than 20 per cent of the variance in spelling ability can be found in the covariance of personality traits. This means that small fluctuations in the samples successively drawn from the population could result in relatively large fluctuations in direction and degree for any differential effect which the best and worst spellers may manifest on the personality subscales or on the items, as the case may be. This situation is further aggravated by the fact that the content of the personality items and/or scales exhibit a great deal of overlap; and, furthermore, within any one sample of students the tests of significance used to determine differences cannot be truly independent. In the past it has been assumed, without mathematical justification, that this nonindependence would result in an increase in the number of type I errors. However, Block (2), in a recent paper, produces evidence to show that when one holds to the classical model (i.e., the 1 and 5 per cent levels of confidence on the normal probability curve) for nonindependent tests of significance, he may, in fact, be committing a type II error. In other words, Block shows that empirically generated probability curves on personality data, very similar to those used in the present study, indicate that the traditional techniques may be statistically "overly conservative by a factor of 3 or 4."

The working hypothesis in the present study may be stated thus: It is unlikely that more than 20 per cent of the variance in spelling ability can be found in the covariance of personality traits. This important preconception sets the tone of the investigation and therefore must be carefully examined. Since the above figure of 20 per cent is obviously based upon the adjudged premise that 80 per cent of the variance of spelling ability could perhaps be accounted for by such factors as rote memory, cognition, visual perception, phonetic association, tonal movement, tonal memory, pitch, and linguistic intelligence, it also needs to be examined. Indeed, it must be recognized at the outset that both figures are rough and ready estimates for the following reasons:

1. The reference population of the present study is college students. Phelan's (26) study dealt with grade-school children. Holmes's (15)

study dealt with high school and college students. Therefore conclusions drawn from Phelan's study and that part of Holmes's study which dealt with high school students can be only indirectly relevant.

2. The major criterion instrument in the present study is a multiple-choice type spelling test. Phelan's (26) criterion of spelling ability was a dictation–write-in type of spelling test composed of "sixty words of appropriate difficulty, selected from Gates' List" and presented in sentence form. Holmes (15) in his high school sample and in both of his college samples used as his criteria the same type of multiple-choice test used in the present study. However, for one of his college groups he also used a modified dictation–write-in spelling test.

3. The following magnitudes were taken into consideration in making the general estimate that 80 per cent of the variance of spelling ability could be "explainable" in terms of known variables:

a. Rote memory, cognition, and visual perception could "explain" 51 per cent of spelling variance.

b. Phonetic association could "explain" from 33 to 48 per cent of spelling variance.

c. Linguistic intelligence could "explain" 14 per cent of spelling variance.

d. Tonal movement, tonal memory, and pitch could "explain" 14 per cent of spelling variance. *These magnitudes, obviously, cannot be summated because of the interdependence among the variables.* Statistically, in order to combine these estimates, the intercorrelations of the variables within a single sample[4] would have to be known. In the absence of such data, the experimenter had to call upon his experience in the field of spelling and his psychological judgment in estimating the statistical overlap or common variances among the listed variables.

4. In adducing that not more than 20 per cent of the spelling variance will be found to be explainable in terms of personality variables, the intercorrelations between the personality variables used in this study *and* the "independent" variables separately derived in Phelan's (26) and Holmes's (15) studies, of course, could not be taken into consideration. This is an important limitation because the relative magnitude of accounted-for-variance of a dependent variable by a certain set of independent variables is conditioned by the degree to which the intercorrelations among these variables approach zero. To put it another way, let R_A^2 be the square of the multiple correlation coefficient of the criterion variable with a set A of explanatory variables, and let R_B^2 be the same statistic for the same criterion variable with another set B of

[4] A study to do just this is now being planned.

explanatory variables (where we assume for simplicity that sets A and B do not contain the same variables). Then,

$$R_{A+B}^2 \leq R_A^2 + R_B^2$$

equality holding if, and only if the variables in set A correlate zero with the variables in set B. Now, though it is highly improbable that the intercorrelations between the "explanatory" variables derived from Phelan's (26) and Holmes's (15) studies *and* the personality factors used in the present study will have intercorrelations that are zero, it seems reasonable to believe that when such intercorrelations are calculated[5] they will turn out to be relatively low.

At any rate, it should be recognized that the magnitude of the figure in the statement, "It is unlikely that more than 20 per cent of the variance in spelling ability can be found in the covariance of personality traits," is a considered judgment made by the experimenter on the basis of his psychoeducational experience.

II. SAMPLES, VARIABLES, AND EXPERIMENTAL DESIGN

Samples

Independent samples were drawn in successive semesters from a population of students enrolled in educational psychology classes at the University of California. The majority of these students were juniors and seniors, with a few graduate students in each sample. Their grade-point averages and their intelligence test scores indicate that in general they were selected from the upper two thirds of the University's upper division population. In this respect, then, each sample constitutes a more homogeneous group than the usual university class. However, because the students had a diversity of teaching majors (e.g., physics, English, biology, language, history, etc.), each sample is more heterogeneous than the usual upper division class. More will be given regarding the make-up of the individual samples under the subtitle, "The Experimental Design."

Criterion Variables

Spelling ability was assessed on two types of instruments:

1. In the first instance two forms of a dictation–write-in type of Word Pleasantness (Spelling) Test was used. These forms contained 100 and 79 items, and were designed to measure the type of spelling ability needed by an individual to write a word when his attention is for the most part occupied with what he is writing about rather than simply

[5] See note 4.

trying to spell words. The words were administered twice; first, as a word-association test, and second, as a word-pleasantness test. *Ability to spell the controlled lists of stimulus words* was assessed (unbeknown to the student) in the word-pleasantness phase of the test.

The words to be spelled, that is, the STIMULUS words, were selected from such spelling scales as those of Ayer (1) and Buckingham and Dolch (3) and also from such free association lists as those given by Rosanoff (28) and Rapaport (27). The list was given orally, and the students were instructed to write their freely associated RESPONSES in the blanks on the left-hand side of their protocols. After the list had been given once, each STIMULUS word was given again, only this time the students wrote the original STIMULUS word in one of three columns to the right of their already written responses to the stimulus word. The spelling test was labeled simply Word Pleasantness Test because emphasis was placed on putting the stimulus word in one of the three columns—(P) Pleasant, (I) Indifferent, or (U) Unpleasant—rather than on trying to spell it correctly. This technique was calculated to reduce cheating and carryover in general, and in particular, to sample the students' spelling abilities under conditions that more normally approximate the task of spelling a word that comes to mind while writing. The schools are often criticized because parents find little relation between their children's ability to spell words in a dictated spelling list and their ability to spell these same words while writing a composition. The present technique, then, is an effort to get at this more functional type of spelling ability, but under controlled conditions.

2. The second instrument was a 50-item, 5-choice multiple-choice College Level Spelling Test devised to measure the type of spelling ability needed by a printer's proofreader. The words used in this test (MC Spelling Test) were selected from items missed in one of the above Word Pleasantness Tests. The wrong choices were selected from words having frequent misses as tallied from the responses given by university students in an earlier study (15). The items were arranged in order of increasing difficulty, and the correct choices were distributed from item to item as dictated by the table of random numbers.

Reliabilities.—The corrected split-half reliabilities for the two forms of the WP Spelling test were .85 and .86. A test-retest reliability on two forms of the WP Spelling tests yields an r of .89. The corrected split-half reliabilities for the MC Spelling test, given to two different sample groups came out to be .76 and .85, respectively.

Validities.—The validity of a test indicates the degree to which it actually measures or predicts the ability it purports to assess. Logical

validity, or face validity, of these tests is assured by the way the tests were constructed.

From an item analysis on a preliminary sample, items in the WP and MC Spelling tests were constructed from easy- to difficult-to-spell items on the basis of the increasing frequency with which the words were misspelled. Furthermore, an empirical analysis shows these two tests to have sufficient powers of discrimination to array the students in the various college samples into what approximates a normal distribution on their ability to spell the words. The word "approximates" is used, because in some samples the tests did not do full justice to the very best spellers. That is, each test could have profited by having a little more "top."

An estimate of the discriminating power of the WP Spelling Test may be ascertained by studying the standard deviations in spelling ability for the total groups and also for the best and worst spellers as given in tables 11; 12*a, b, c*; 17*a, b*; and 18. For the MC Spelling Test, similar evidence may be found in tables 6*a, b, c;* 9*a, b, c;* 15*a, b*; 18; 22*a, b, c*; 25; and also in tables 5; 8; 14*a, b*; 17*a* and 17*b*. The evidence, then, supports the notion that these tests nicely differentiate these students on their ability to spell.

Finally a separate validity measure is provided by noting how the two types of spelling tests correlate with each other. In one sample of 94 students, a concurrent validity coefficient of .85 was obtained as an estimate of agreement in the spelling scores made by students taking the WP (modified dictation–write-in type) spelling test *and* the MC (multiple-choice type) test.

Independent Variables

Inventories used in the present study were selected because they are of the "objective" type. A great deal of work has been done on each of these instruments listed below, with the result that the traits which they purport to measure in their various subscales are fairly well covered in the literature. Moreover, they are group tests and can therefore be administered to large groups of students with ease. The specific inventories used were:

1. The Heston Personality Adjustment Inventory (HPAI) (high school and college level) by Joseph C. Heston (11). This inventory consists of 270 items categorized into six scales. A high score on any of the scales is supposed to indicate good adjustment in that area. Table 2 gives a description of the scales (12).

2. The Johnson Temperament Analysis (JTA) (grade 12; adults) by Roswell H. Johnson (17). This temperament analysis contains 182

TABLE 2

INTERPRETATIVE MATERIAL ON SUBTESTS[a]

Scale	Interpretation
	HESTON PERSONALITY ADJUSTMENT INVENTORY
AT	Analytical Thinking Thinking introversion; intellectually independent; thinks for himself; likes detailed work; persistent.
S	Sociability (Social Adjustment) Social extroversion; interested in people; makes friends easily; lively.
ES	Emotional Stability Uniform in spirits; free from fears; not easily upset; can relax; realistic outlook.
C	Confidence Makes decisions readily; confident in his judgments; adjusts easily; optimistic; freedom from inferiority feelings.
PR	Personal Relations (Personal Adjustment) Feeling that others are trustworthy and congenial; not annoyed and irritated by others; no feelings of misunderstanding by others; not too critical of others; patient; not angered.
HS	Home Satisfaction Pleasant family relations; feeling of mutual understanding and respect; recognition of duties and obligations.
	JOHNSON TEMPERAMENT ANALYSIS
A	Nervous vs. Composed Restlessness; fidgeting; tenseness; sleeplessness; tendency to worry; muscular incoordination.
B	Depressive vs. Gay-hearted Dispirited; dejected; lowered vital activity; outlook stresses difficulties and burdens beyond their normal importance.
C	Active vs. Quiet Dynamic; lively; hustling; life-of-the-party; "peppy" person known to all. Drive: To do.
D	Cordial vs. Cold Warm-heartedness; suited to social relations; an expressive cheerfulness toward others. Drive: For response and to serve and to express.
E	Sympathetic vs. Hard-boiled Understanding; kindliness; fellow-feeling; and empathic compassion. Drive: To serve.
F	Subjective vs. Objective Self-centered. One of the three principal subdivisions of introvert—the other two being introspective and shy. Drive: To obtain recognition.
G	Aggressive vs. Submissive Pushful; ruthless; ambitious; conceited; persistent and determined. Drive: To exert power.

(Continued)

TABLE 2—*Continued*

Scale	Interpretation
	JOHNSON TEMPERAMENT ANALYSIS—*continued*
H	Critical vs. Appreciative Tendency to censure others. Drive: To obtain ego-inflation.
I	Self-mastery vs. Impulsiveness Tendency to make plans and carry them through relatively undeflected by impulse and caprice. Capacity to decide when and how much to inhibit and act accordingly. Drive: To escape pain, fatigue, failure, etc., and to act to obtain a deferred advantage.
	MINNESOTA MULTIPHASIC PERSONALITY INVENTORY
	Clinical Scales
K	Correction Factor, Persona
F	Scale, attention to details
L	Lie
Hs	Hypochondriasis Concern over bodily functions; concern about health; tendency toward physical complaint; pessimism; dispiritedness; dourness.
D	Depression Dejection; discouragement; despondency; subjective distress.
Hy	Hysteria Immature; unrealistic; amenable to group ideals; kindly; courteous; naïve; needs social acceptance; narcissistic; uninsightful.
Pd	Psychopathic Deviate Irresponsible; undependable; impulsive; egocentric; defiant; asocial; individualistic; tactless; improvident; deficient in ability to calculate own social stimulus value.
Mf	Masculinity–Femininity Males: wide range of interest; impatience; self-satisfied; snobbish; gentle; appreciative. Females: dissatisfied; driving; vigorous; determined.
Pa	Paranoia Aggressive; critical; irritable; moody; sensitive; easily hurt by criticism; stubborn; skeptical.
Pt	Psychasthenia Apprehensive; tense; hesitant; insecure; self-conscious; feelings of inadequacy; perplexed; anxious; agitated.
Sc	Schizophrenia Bashful; withdrawn; oversensitive; secretive; cautious; uncertain; diffident; resigned.
Ma	Hypomania Confident; hypersensitive; not persistent; aggressive; charming; expansive; irritable; impatient.

TABLE 2—*Continued*

Scale	Interpretation
	MINNESOTA MULTIPHASIC PERSONALITY INVENTORY—*continued*
	Added Scales
Pr	Prejudice Cynicism; poor morale; suspiciousness; feeling of ill will; lack of faith in others.
Ac	Academic Achievement Tenseness; docility; insecurity (producing greater academic output).
St	Social Status Self-confidence; poise; resourcefulness.
Re	Responsibility Dependability; integrity; seriousness; steadiness; tenacity.
Do	Dominance Optimism; persuasiveness; self-discipline; resoluteness.
Sp	Social Participation Self-assured; active; poised; organized; independent.
IF	Intellectual Functioning Efficient; self-confident; energetic; realistic; insightful.
Si	Social Introversion Tendency to avoid social contact; little dependency upon people.
Ds	Dissimulation Dissatisfied; resentful and pessimistic; self-pitying; dispirited; complaining; hypocrisy; deception.

[a] Sources: Tyler (36), Michaelis (25), Johnson (18), Gough (8), Heston (12), Hathaway and McKinley (10).

items and purports to assay a person's more fundamental characteristic behavior tendencies. Unweighted scores were used. The author (18) points out that six of the traits are bipolar (i.e., have better zones nearer the mean and poorer toward the two extremes); two, Nervous and Depressive, have their optimums at or very near the minimum. Table 2 presents a description of the eight scales in the inventory.

3. The Minnesota Multiphasic Personality Inventory (MMPI) (revised edition) by Starke R. Hathaway and J. Charnley McKinley (9). This instrument contains 566 items in the booklet. As will be made clear later, workers like Gough (8) have developed a number of scales in addition to the scales originally presented by the authors. In the present study, the nine clinical scales were used with one sample, and combinations of the clinical and the "added" scales were used with other samples. High scores on the clinical scales indicate that the subject is "experiencing" difficulties in these areas. However, a high score on some of the "added" scales is associated with a socially valued tendency. Table 2 presents a detailed description of the scales.

4. The American Council on Education Psychological Examination for College Freshmen (ACE) by L. L. and T. G. Thurstone (35). This instrument purports to test the "L" or linguistic intelligence as well as the "Q" or quantitative intelligence.

Reliability of Independent Variables

Reliabilities of the personality inventories are reported in table 3, together with those for the two spelling tests and the intelligence test. Tyler (36), perhaps, has given closer attention to the reliabilities of these three personality inventories than has any other investigator. After considering the assumptions relating to the equality of means and sigmas in calculating a split-test reliability of a personality test, Tyler tried an odd-even split and a random split and found that the two gave similar results.

The values of the two types of estimates from Tyler's study (36) in regard to the Minnesota Multiphasic Personality Inventory (MMPI) are presented in table 3.

The reliabilities on the Johnson Temperament Analysis (JTA) as obtained by Tyler (36) are likewise presented in table 3 with those taken from the manual (18). Reliabilities on the JTA were calculated by Holmes (13) in a previous study, and these have been also included in table 3. It will be observed that in some instances Tyler's results agree more with Holmes's, but in other instances his results agree more with the reliabilities presented in the manual. Michaelis (25), likewise, calculated reliabilities not only for the nine clinical scales of the MMPI but also for the nine "added" scales. His results are listed in table 3. Michaelis (25) also calculated the reliabilities of the subscales on the Heston Personality Adjustment Inventory (HPAI). Table 3 contains his results.

The careful work of both Tyler (36) and Michaelis (25) stands as a warning to all who would venture into the area of individual diagnosis and prediction with these objective personality assessment instruments, but it should be pointed out that Kelley's (19) high reliability criterion of .94 for individual diagnosis is not applicable to all situations in which personality scales are used.

The minimal standard of reliability coefficient for group testing, by Kelley's (19) own statement, is only .50. Since *in the present study we are searching only for group relationships,* it should be profitable to substitute or accept the less rigorous group standard for the more rigorous reliability standard set up by Kelley for individual diagnosis. Hence all 33 personality subscales were used in the present study in the hope that a search from every available angle might shed some light

TABLE 3

COMPARATIVE RELIABILITY COEFFICIENTS OF VARIABLES

Tests	Manual	Tyler	Other
HOLMES SPELLING CRITERION ASSESSMENTS			
MC Spelling Test	.76[a]		.85[a]
WP Spelling Test	.89		.89
HESTON PERSONALITY ADJUSTMENT INVENTORY			
A Analytical Thinking	.86[b]	.73[c]	.81[d]
S Social Adjustment	.91	.90	.91
E Emotional Stability	.86	.86	.86
C Confidence	.84	.90	.89
P Personal Adjustment	.80	.81	.81
H Home Satisfaction	.87	.90	.89
JOHNSON TEMPERAMENT ANALYSIS			
A Nervous—Composed	.76[e]	.66[f]	.53[g]
B Depressed—Gay-hearted	.75	.81	.68
C Active—Quiet	.72	.68	.62
D Cordial—Cold	.77	.73	.77
E Sympathetic—Hard-boiled	.57	.55	.12
F Subjective—Objective	.71	.58	.45
G Aggressive—Submissive	.65	.38	.44
H Critical—Appreciative	.78	.77	.54
I Self-mastery—Impulsive	.76	.75	.64
MINNESOTA MULTIPHASIC PERSONALITY INVENTORY			
Hs Hypochondriasis (Health)	.72[h]	.83[i]	.81[j]
D Depression (Morale)	.56	.65	.62
Hy Hysteria (Realism)	.44	.44	.71
Pd Psychopathic Deviate (Irresponsibility)	.43	.43	.35
Mf Interest (Toward Opposite Sex)	.43	.55	.41
Pa Paranoia (Aggressive)	.45	.17	.44
Pt Psychasthenia (Worry)	.86	.91	
Sc Schizophrenia (Withdrawing)	.82	.85	.85
Ma Hypomania (Expansive)	.56	.28	.56
Ac Achievement (Academic)			.54[k]
Do Dominance			.37
St Social Status			.48
Pr Prejudice			.54
IF Intellectual Functioning			.80
Sp Social Participation			.59
Ds Dissimulation			.80
Si Social Introversion			.81
Re Responsibility (Dependability)			.52
AMERICAN COUNCIL ON EDUCATION PSYCHOLOGICAL EXAMINATION			
Q Quantitative Intelligence			.95[l]
L Linguistic Intelligence			.91

[a] Holmes (15).
[b] Heston (12), Manual.
[c] Tyler (36), Table 7.
[d] Michaelis (25), Table 5.
[e] Johnson (18), Manual.
[f] Tyler (36), p. 245.
[g] Holmes (13), Table 4.
[h] Hathaway, *et al.* (10).
[i] Tyler (36), Table 7.
[j] Tyler (36), Table 7.
[k] Michaelis (25).
[l] Holmes (15).

TABLE 4

OUTLINE OF THE EXPERIMENTAL DESIGN, INDICATING SEX, SAMPLE SIZE, CRITERION TESTS, AND INDEPENDENT VARIABLES

Semester[a]	Sample	Males	Females	Total	Criterion	Independent variables
F. 1952, S. 1953	I	70	113	183	MC Sp.	Heston Personality (6 scales)
F. 1951	II	43	87	130	MC Sp.	Johnson Temperament (9 scales)
F. 1950	III	42	59	101	WP Sp.	MMPI (L, F, K, Hs, D, Hy, Pd, Mf, Pa, Pt, Sc, Ma)
S. 1951	IV_1	43	51	94	MC Sp.	MMPI (L, F, K, Hs, D, Hy, Pd, Mf, Pa, Pt, Sc, Ma)
S. 1951	IV_2	43	51	94	WP, MC Sp.	MMPI (L, F, K, Hs, D, Hy, Pd, Mf, Pa, Pt, Sc, Ma; + Ac, Do, St, Pr, IF, Sp, Ds, Si, Re; + ACE)
F. 1954	V	62	134	196	MC Sp.	*Composite Battery:* Selected on the basis of those subtests in the above four samples which gave evidence of making an independent contribution to the variance of spelling ability. Item analysis made of composite battery. Selected items to be included in Psychoscope I.
F. 1954	VI	87	279	366	MC Sp.	Item analysis of Psychoscope I, construction of Psychoscope II.
S. 1955	VII	138	391	529	MC Sp.	Final validation of personality items in Psychoscope II, construction of Psychoscope III.
Total		485	1,114	1,599		

[a] Arranged for convenience rather than in the order taken.

on the problem. Nevertheless, safeguards have been set up. Specifically the reader's attention is called to the fact that four other types of checks were incorporated in the present study in order to offset those chance relationships which might appear by reason of sampling error or test unreliability: (1) A constant check was made in utilizing the Wherry-Doolittle Test Selection Method (7, 38, 39), to be sure that the "A-row" value did not drop below the reliability of the test being selected. (2) Every selected personality subscale was successively cross validated on at least one other separate sample of students independently drawn from the "same" population. (3) A successive cross validation was made of the final items taken from those personality subtests which had themselves been selected because they had seemed to "hold up" on at least two previous samples. Finally (4) the Wherry shrinkage formula (7, 38, 39) was used to correct for systematic errors in the multiple correlation coefficient.

Experimental Design

Table 4 presents the schematic outline of the design of the experiment. The procedure followed was to draw successive samples from the same universe of students enrolled in educational psychology classes at the University of California. To each of these samples at least one spelling test and a personality inventory were administered. Care was taken to eliminate any overlap of students from one sample to another.

The principal analytical procedure followed was to calculate the intercorrelations among the spelling and personality subtests for the sample under investigation. In each sample three separate matrices were calculated: for men, for women, and for the total sample. When both spelling criteria were used, matrices for both sexes and the total sample were also set up for each type of spelling criterion.

Finally, each matrix was submitted to a multivariate analysis. The Wherry-Doolittle Multiple Correlation Test Selection Method (7, 38, 39) was used in order to precipitate out of each matrix that battery of personality subtests which would most efficiently predict the criterion—spelling ability. Further, the independent contribution to the variance in spelling ability which each of the personality subtests made was determined by multiplying for each variable its partial regression coefficient in standardized form by its zero-order correlation coefficient with the criterion.

The shrinkage formula used in the present study is designed to correct[6] for systematic errors in multiple correlation coefficients derived

[6] Although this correction appears to be the best the statistician has to offer under the circumstances, it should be recognized that it is only a partial correction. Furthermore, as other such corrections, it is least effective when applied to sets of variables exhibiting high intercorrelations.

from prediction equations (especially using many variables) so that they would more nearly agree with correlation coefficients obtained from actual data. Wherry (39) has pointed out that his original formula (7, 38) contained a slight error in its denominator; the correct equation is:

$$\bar{R}^2 = 1 - \left[(1 - R^2)\left(\frac{N-1}{N-m-1}\right)\right].$$

Where $\bar{R}$ represents the shrunken multiple correlation coefficient from which systematic error has been removed (i.e., estimated correlation obtaining in the universe); R represents, of course, the uncorrected multiple correlation; N represents the number of observations or students in the sample (men, women, or total); m represents the number of independent variables already selected as best predictors of the criterion.

The following data will aid in interpreting table 4. Seventy males and 113 females constitute sample I. The 5-choice multiple-choice spelling test was utilized as the criterion against which the six scales of the HPAI were related in order to obtain a "best" battery of predictor tests. In a similar manner 43 men and 87 women were used with the nine scales of the JTA. In sample III, 42 males and 59 females were given the free association Word Pleasantness (WP SPELLING) Test and the nine clinical scales of the MMPI plus three validating scales (i.e., L, K, F). In sample $IV_{1,2}$ both criteria were used. In the first series of calculations, the nine clinical plus the three validity scales were used. In the second series of calculations, all twenty-one MMPI scales were utilized plus the ACE.

In sample V, all the scales which had been selected, on the basis of the Wherry-Doolittle Test Selection Method (7, 38, 39) in samples I, II, III, IV_1 and IV_2, were now collected into a single Composite Battery and administered with the MC Spelling Test to 62 males and 134 females. Finally, the intercorrelation matrices for these derived personality subtests and the MC Spelling Test were analyzed to determine whether any of these personality subtests would "hold up" in cross validation.

The second phase of the study has to do with successive sample item analyses. The original thirty-three personality scales contained 1,018 items. The Composite Battery contained 640 items. These were item analyzed and all items which differentiated between the best and worst spellers for the men, women, and total were selected to be included in a new spelling-personality scale, Psychoscope I. Keys were designed to

score all items so that best spellers would have the greatest probability of making the "right" responses.

Psychoscope I was now administered with a spelling test to sample VI. The responses of the top and bottom 27 per cent of the sample (i.e., best and worst spellers) for the men, women, and total were again item analyzed. Those items which were consistent for a second time in differentiating best from worst[7] spellers and also passed a rather liberal chi-square test were now collected into a new battery, Psychoscope II.

Psychoscope II was now administered with a spelling test to a new group of 529 college students drawn like sample VII from the educational psychology classes during the spring of 1955. Once again, those items which had been consistent in discriminating the best from the worst spellers for the men or the women on this and all previous item-analyses, and also in showing an "acceptable" per cent discrimination and discrimination-index on sample VII, were selected as items stable enough to be reported as core-items for Psychoscope III. Psychoscope III has as its objective the assessment of a spelling-personality in men and women at the college level.

In brief, the analytical procedures consist, first, of combining the Wherry-Doolittle Test Selection Method with a successive sampling technique, and second, of combining item analyses with successive sampling. The crux of what is here called the Method of Successive Analysis is the systematic selection of subtests or items on the basis of their functional discrimination and stability in relation to a criterion on successive samples drawn from the same population. Although the method of successive analyses, per se, has long been used in both psychology and education, the combination of cross validating successive samples by using the Wherry-Doolittle Test Selection Method, and then following up the surviving tests by cross validating the items therein does seem to be new. The relationship of the methodology to sequential analysis (37) is only superficial. However, in both techniques an effort is made to design an experiment that will lose the minimum amount of precision and gain the maximum amount of efficiency in cost and time necessary to find the answer to a problem.

III. RESULTS

Sample I, Heston Personality Adjustment Inventory

Table 5 presents a comparison of the mean subtest scores for the best and worst spellers taking the HPAI. The t-ratio of the difference be-

[7] Wherever best and worst spellers are referred to, they were selected by taking those students in any sample under consideration whose spelling scores placed them in the top or bottom 27 per cent of the sample (actual sub-N's were adjusted to logical cutting points at approximately 27 per cent of total N).

TABLE 5

COMPARISON OF MEAN PERSONALITY SUBTEST SCORES ON THE HESTON PERSONALITY ADJUSTMENT INVENTORY FOR BEST AND WORST SPELLERS

(Sample I)

Variable	Best spellers			Worst spellers			*t*-ratio of difference between means	P value
	N	Mean	Standard deviation	*N*	Mean	Standard deviation		
MEN (N = 70; df 18)								
MC Spelling	19	45.68	1.62	19	34.10	2.68	+15.69	<.001
A Analytical Thinking	19	27.21	5.36	19	24.26	6.35	+ 1.51	<.13
S Social Adjustment	19	25.00	9.06	19	27.58	7.00	− .96	
E Emotional Stability	19	28.32	8.01	19	29.95	6.36	− .68	
C Confidence	19	26.32	7.93	19	28.68	8.12	− .88	
P Personal Adjustment	19	26.40	5.99	19	26.63	5.69	− .18	
H Home Satisfaction	19	37.05	6.27	19	36.95	8.70	+ .04	
WOMEN (N = 113; df 29)								
MC Spelling	30	46.33	1.47	30	35.17	2.99	+18.12	<.001
A Analytical Thinking	30	26.77	4.77	30	25.70	5.58	+ .79	
S Social Adjustment	30	29.33	8.31	30	26.70	9.01	+ 1.15	
E Emotional Stability	30	27.23	7.11	30	26.50	6.95	+ .39	
C Confidence	30	26.97	7.84	30	26.77	8.08	+ .10	
P Personal Adjustment	30	27.90	4.85	30	27.13	5.22	+ .58	
H Home Satisfaction	30	37.07	9.08	30	38.37	9.32	− .54	

TABLE 6a

INTERCORRELATIONS BETWEEN SPELLING AND THE HESTON PERSONAL ADJUSTMENT INVENTORY FOR 70 UNIVERSITY MEN
(Sample I)

Variable	MC Sp	A	S	E	C	P	H
MC Spelling	...	.22	−.15	−.12	−.14	−.05	−.11
A Analytical Thinking	...	...	−.00	.09	.19	.06	.25
S Social Adjustment		...	...	.53	.58	.51	.20
E Emotional Stability			...	...	.78	.74	.31
C Confidence				...	...	.66	.31
P Personal Adjustment					...	...	.32
H Home Satisfaction						...	...
Mean	40.3	26.1	25.3	29.5	27.8	26.8	35.6
S.D.	4.7	5.8	9.3	6.9	7.4	5.8	9.3

TABLE 6b

INTERCORRELATIONS BETWEEN SPELLING AND THE HESTON PERSONAL ADJUSTMENT INVENTORY FOR 113 UNIVERSITY WOMEN

Variable	MC Sp	A	S	E	C	P	H
MC Spelling	...	.16	.05	.04	.03	.07	−.05
A Analytical Thinking	...	...	.05	.05	.28	.11	.09
S Social Adjustment		...	...	.32	.62	.29	.24
E Emotional Stability			...	...	.68	.65	.33
C Confidence				...	...	.62	.35
P Personal Adjustment					...	...	.40
H Home Satisfaction							...
Mean	41.1	26.6	27.4	27.3	27.1	27.2	37.2
S.D.	4.6	5.6	8.2	7.3	7.9	4.9	9.5

tween the means indicates that, for men, only one personality variable, Analytical Thinking, comes close to the rather liberal confidence level of 10 per cent. For women, not even one personality variable on the HPAI shows a significant difference between the means of the best and worst spellers in this sample.

Tables 6*a*, 6*b*, and 6*c* present the intercorrelations for the 70 men, 113 women, and the total sample of 183 students in sample I. The means and standard deviations are given at the bottom of each matrix. Inspection of the zero-order r's with the criterion indicates that in general those obtained for the men are higher than those for the women. This

being the case, as would be expected, the zero-order r's between the criterion and the independent variables for the total sample lie somewhere between those represented for the men and those represented for the women. This is exactly the reason for the separate analysis of the sexes, that is, to avoid masking any true but differing effects in each sex, should they appear.

Inspection of the matrix in table 6*a* (men) will reveal that, with the exception of Analytical Thinking, the personality factors of the Heston

TABLE 6c

INTERCORRELATIONS BETWEEN SPELLING AND THE HESTON PERSONAL ADJUSTMENT INVENTORY FOR 183 UNIVERSITY STUDENTS

Variable	MC Sp	A	S	E	C	P	H
MC Spelling	...	.19	−.02	−.04	−.04	.02	−.07
A Analytical Thinking		...	.03	.06	.24	.09	−.14
S Social Adjustment			...	.38	.59	.39	.22
E Emotional Stability				...	.71	.67	.31
C Confidence					...	.63	.33
P Personal Adjustment						...	.36
H Home Satisfaction							...
Mean	40.8	26.4	26.6	28.1	27.4	27.1	36.6
S.D.	4.7	5.7	8.7	7.2	7.7	5.2	9.4

scale are all negatively related to spelling ability. Since high scores on the HPAI are associated with "good" adjustment, this would indicate that the *better men spellers tend to be slightly more unadjusted* in the areas of Sociability, Emotional Stability, Confidence, Personal Relations, and Home Satisfaction. Reference to table 6*b* indicates that *just the reverse of this appears to be true for the women*! All this would be interesting indeed, if true, but it must be well noted that not one of these correlations for either sex reaches the 5 per cent level of confidence. In other words, only Analytical Thinking (with an r of .22 for men, and .16 for women) seems to be statistically related to spelling at what approaches an acceptable level of confidence.

Even if none of the independent variables in this sample were to show a relationship to spelling ability that was statistically significant at some predetermined standard, such as the 5 per cent level of confidence, it would still be possible for a combination of these variables to make a significant contribution to the variance of spelling ability. In order to test for this possibility, the multiple $\bar{R}$'s were calculated by utilizing the Wherry-Doolittle Test Selection Method (7, 38, 39).

Table 7 presents the increase in the multiple $\bar{R}$'s as each new test is selected and added to those already selected. The appropriate zero-order r's are given alongside the multiple $\bar{R}$'s for ready comparisons. In the same table both the total and independent contributions which the selected variables make to the variance of MC Spelling ability are given.

TABLE 7

INCREASE IN THE MULTIPLE $\bar{R}$ PREDICTING SPELLING ABILITY AS EACH NEW SELECTED PERSONALITY VARIABLE IS ADDED
(Sample I—MC Spelling)

Variable	Zero-order r	Cumulative $\bar{R}$	Contribution to variance[a] (per cent)	Total per cent
A. MEN (N = 70)				
A Analytical Thinking.....	+.22	.19	5.7	...
C Confidence.....	−.14	.24	2.7	8.4
B. WOMEN (N = 113)				
A Analytical Thinking.....	+.16	.13	2.4	2.4
C. TOTAL SAMPLE (N = 183)				
A Analytical Thinking.....	+.19	.17	3.9	
C Confidence.....	−.04	.18	.4	4.3

[a] In final set for Sample I only.

Table 7 reveals that Analytical Thinking is the most important predictive variable in this battery of personality tests. It not only makes the original and highest contribution to the variance of spelling ability in each subsample, but it is the only personality variable that makes an independent contribution to the spelling ability of women. For men, Confidence is negatively correlated with spelling; therefore, the relative lack of Confidence tends to raise the multiple correlation and adds another 2.7 per cent to the 5.7 per cent of spelling ability variance already accounted for by Analytical Thinking. In the total sample, Analytical Thinking and Confidence together contribute 4.3 per cent to the variance of spelling ability.

In line with the experimental design outlined earlier, the personality variables, Analytical Thinking and Confidence, from the HPAI were selected to be tried again in combination with other such variables (selected from the other "primary" personality batteries) on a new sample of college students.

TABLE 8

COMPARISON OF MEAN PERSONALITY SUBTEST SCORES ON THE JOHNSON TEMPERAMENT ANALYSIS FOR BEST AND WORST SPELLERS
(Sample II)

Variable	Best spellers			Worst spellers			*t*-ratio of difference between means	P value
	N	Mean	Standard deviation	*N*	Mean	Standard deviation		
MEN ($N = 43$; df 11)								
MC Spelling	12	47.00	.82	12	32.08	2.66	+17.76	<.001
A Nervous	12	7.67	2.33	12	4.33	3.17	+ 2.81	<.02
B Depressed	12	6.67	3.33	12	4.08	3.23	+ 1.85	<.10
C Active	12	10.17	3.08	12	10.17	2.58	.00	
D Cordial	12	12.58	3.73	12	12.75	2.97	− .13	
E Sympathetic	12	13.50	2.69	12	13.75	2.72	− .22	
F Subjective	12	8.67	2.50	12	6.25	2.89	+ 2.10	<.10
G Aggressive	12	8.25	3.03	12	7.00	3.19	+ .94	
H Critical	12	8.25	2.89	12	4.92	3.35	+ 2.50	<.05
I Self-Mastery	12	11.33	3.82	12	13.00	3.39	− 1.08	
WOMEN ($N = 87$, df 22)								
MC Spelling	23	46.39	1.60	23	36.04	1.68	+21.12	<.001
A Nervous	23	4.35	3.33	23	6.17	3.38	− 1.84	<.10
B Depressed	23	4.48	3.73	23	5.83	3.32	− 1.27	
C Active	23	10.87	2.78	23	9.70	3.97	+ 1.13	
D Cordial	23	14.65	3.10	23	14.35	3.65	+ .29	
E Sympathetic	23	15.17	2.12	23	14.48	2.30	+ 1.04	
F Subjective	23	6.52	3.10	23	6.44	3.23	+ .08	
G Aggressive	23	8.74	3.16	23	8.17	2.07	+ .72	
H Critical	23	6.09	4.74	23	4.78	2.48	+ 1.15	
I Self-Mastery	23	14.17	3.72	23	14.13	3.09	+ .04	

Sample II, Johnson Temperament Analysis

Table 8 compares the mean subtest scores for the best and worst spellers taking the JTA. The t-ratio of the difference between the means indicates that for men, Nervous, Depressed, Subjective, and Criticalness are all significant at better than the 10 per cent level of confidence. For women, Nervous seems to be the only one that separates the best from the worst spellers with any acceptable degree of confidence.

Besides the fact that more personality variables seem to be related to spelling ability of men than of women in this sample, the difference in the direction of the relationship is most striking in the signs and magnitudes of the t-ratios for the variable Nervousness-vs-Composure. This being a bipolar trait, it is interesting to note that though the best men spellers are more Nervous, the best women spellers are more Composed!

Tables 9*a*, 9*b*, and 9*c* present the intercorrelations for the 43 men, the 87 women, and the total sample of 130 students in sample II. Means and standard deviations are also given. A comparison of the criterion zero-order r's indicates that, in general, the relations between these variables and spelling seem to be slightly higher for men than for women.

Corroborating the findings presented in table 8, the correlations in tables 9*a* and 9*b* indicate that there seems to be a tendency for the opposite sexes to have the personality variables Nervousness and Depressiveness related to their spelling abilities in exactly opposite directions. For men, the better spellers are more Nervous ($r = +.33$) and Depressed ($r = +.27$), whereas for women, better spellers are more Composed ($r = -.15$) and slightly more Gay-hearted ($r = -.05$)! On the other hand, both sexes show a relation between spelling and Criticalness which is positive and significant at about the 10 and 15 per cent levels of confiidence for the men and women, respectively. The highest criterion correlation for the women is Active ($r = +.20$). This variable shows no relation to spelling for the men.

Table 10 gives the increase in the multiple $\bar{R}$'s as each new test is selected and added to those already selected. The appropriate zero-order r's are given with the multiple $\bar{R}$'s for ready comparisons. In the same table both the total and independent contributions which the selected variables made to the variance of MC Spelling ability are given.

Scrutiny of table 10 reveals that for men, Nervous is the most important personality test and contributes about 13 per cent to the variance of spelling ability. Beyond this, both Self-Mastery and Criticalness make quite sizable contributions, the three together contributing 31.8 per cent to the variance of spelling ability for men in sample II. For women, Active comes out first, but Criticalness makes the largest con-

TABLE 9a

INTERCORRELATIONS BETWEEN MC SPELLING AND THE JOHNSON TEMPERAMENT ANALYSIS FOR 43 UNIVERSITY MEN
(Sample II)

Variable	MC Sp.	Nerv. A	Dep. B	Act. C	Cord. D	Symp. E	Subj. F	Aggr. G	Crit. H	S–M I
MC Spelling	...	.33	.27	.03	.03	.09	.12	.13	.24	.14
A Nervous		...	.64	−.15	−.12	−.13	.47	.04	.48	−.46
B Depressive			...	−.39	−.29	−.22	.45	−.07	.40	−.40
C Active				...	.34	.28	−.08	.43	.06	.26
D Cordiality					...	.14	−.23	.14	.09	−.00
E Sympathy						...	−.47	−.15	−.31	.26
F Subjectivity							...	.26	.69	−.48
G Aggressive								...	.26	.09
H Criticalness									...	−.63
I Self-Mastery										...
Mean	40.0	5.3	5.1	10.3	13.2	13.8	7.3	8.3	6.1	12.9
S.D.	6.1	3.0	3.1	2.9	3.4	3.0	3.4	3.2	3.4	3.8

TABLE 9b

INTERCORRELATIONS BETWEEN MC SPELLING AND THE JOHNSON TEMPERAMENT ANALYSIS FOR 87 UNIVERSITY WOMEN

Variable	MC Sp.	Nerv. A	Dep. B	Act. C	Cord. D	Symp. E	Subj. F	Aggr. G	Crit. H	S-M I
MC Spelling	...	−.15	−.05	.20	.06	.06	.05	.09	.17	.02
A Nervous		...	.73	−.35	−.34	−.25	.52	−.32	.54	−.55
B Depressive			...	−.36	−.56	−.21	.43	−.22	.45	−.47
C Active				...	.65	.24	−.39	.45	−.07	.14
D Cordiality					...	.28	−.31	.23	−.08	.20
E Sympathy						...	−.35	−.03	−.27	.19
F Subjectivity							...	−.18	.59	−.45
G Aggressive								...	−.06	.26
H Criticalness									...	.44
I Self-Mastery										...
Mean	41.4	5.3	4.8	10.6	14.7	14.7	7.0	8.7	5.4	14.2
S.D.	4.1	3.2	3.5	3.1	3.4	2.4	3.3	2.6	3.6	3.2

TABLE 9c

INTERCORRELATIONS BETWEEN MC SPELLING AND THE JOHNSON TEMPERAMENT ANALYSIS FOR TOTAL OF 130 UNIVERSITY STUDENTS

Variable	MC Sp.	Nerv. A	Dep. B	Act. C	Cord. D	Symp. E	Subj. F	Aggr. G	Crit. H	S–M I
MC Spelling	...	.04	.06	.11	.06	.08	.06	.10	.15	−.04
A Nervous		...	.70	−.29	−.26	−.20	.50	−.18	.52	−.51
B Depressive			...	−.37	−.47	−.21	.44	−.16	.44	−.44
C Active				...	.55	.26	−.29	.44	−.03	.19
D Cordiality					...	.25	−.20	.21	−.04	.16
E Sympathy						...	−.40	−.03	−.30	.25
F Subjectivity							...	−.01	.62	−.46
G Aggressive								...	.04	.20
H Criticalness									...	−.52
I Self-Mastery										...
Mean	41.0	5.3	4.9	10.5	14.2	14.4	7.1	8.6	5.6	13.8
S.D.	5.8	3.2	3.4	3.0	3.5	2.6	3.3	2.8	3.6	3.4

tribution to the variance of spelling ability. Likewise, though Nervousness comes out third, it makes a greater contribution to the variance of spelling than does Active. Explanation of this anomaly apparently rests in the fact that though Active and Criticalness are positively related to spelling, Nervous is positively related to Criticalness but is

TABLE 10

INCREASE IN THE MULTIPLE $\overline{R}$ PREDICTING SPELLING ABILITY AS EACH NEW SELECTED PERSONALITY VARIABLE IS ADDED
(Sample II—MC Spelling)

Variable	Zero-order r	Cumulative $\overline{R}$	Contribution to variance[a] (per cent)	Total per cent
A. MEN (N = 43)				
A Nervous	+.33	.30	13.2	
I Self-Mastery	+.14	.42	8.2	
H Criticalness	+.24	.51	10.4	31.8
B. WOMEN (N = 87)				
C Active	+.20	.17	2.4	
H Criticalness	+.17	.25	5.8	
A Nervous	−.15	.30	4.2	12.4
C. TOTALS (N = 130)				
H Criticalness	+.15	.13	2.9	
E Sympathy	+.08	.16	1.2	
G Aggressive	+.10	.17	1.1	5.2

[a] In final set for Sample II only.

negatively related to spelling, the suppressor effect (40) seems to be exerting its influence here.

Section *c* of table 10 indicates that when men and women are combined into a total sample, Criticalness becomes the single most important personality element of common importance to good spelling ability. Sympathy and Aggressiveness each make small independent contributions beyond that made by Criticalness. Most interesting to observe, however, from a statistical point of view, is the fact that though Nervousness appeared separately for men and for women, because the contributions are made in opposite directions, the mutually opposite effects of Nervousness on spelling mask each other in the combined sample.

From JTA, then, Nervous, Self-Mastery, Critical, Active, Sympathy, and Aggressive scales were added for further analyses to those previously selected from the Heston in sample I.

TABLE 11

COMPARISON OF MEAN PERSONALITY SUBTEST SCORES ON THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY FOR BEST AND WORST SPELLERS

(Sample III)

Variable	Best spellers			Worst spellers			*t*-ratio of difference between means	P values
	N	Mean	Standard deviation	*N*	Mean	Standard deviation		
MEN (N = 42; df 10)								
WP Spelling	11	97.18	1.04	11	78.54	4.93	+11.72	<.001
L Lie	11	3.45	2.07	11	4.09	2.43	− .63	
K Persona	11	14.82	5.97	11	15.91	5.92	− .41	
F Scale	11	4.82	2.86	11	4.00	3.30	+ .58	
Hs Hypochondriasis	11	4.27	3.32	11	4.18	4.00	+ .05	
D Depression	11	19.55	3.00	11	19.45	5.47	+ .06	
Hy Hysteria	11	20.82	3.46	11	20.91	3.56	− .06	
Pd Psychopathic Deviate	11	13.64	3.61	11	13.45	3.56	+ .12	
Mf Interest	11	[illegible]	[illegible]	11	[illegible]	[illegible]	[illegible]	

Pa Paranoia								
Pt Psychasthenia	11	9.09	6.29	11	9.73	5.85	− .24	
Sc Schizophrenia	11	9.18	6.15	11	9.64	5.44	− .18	
Ma Hypomania	11	13.45	4.23	11	15.18	2.92	− 1.06	
			WOMEN (N = 59; df 15)					
WP Spelling	16	97.00	2.05	16	79.19	4.47	+14.13	<.001
L Lie	16	4.81	3.20	16	4.50	2.50	+ .30	
K Persona	16	14.88	5.28	16	15.50	4.36	− .35	
F Scale	16	3.88	1.80	16	3.25	8.48	+ .75	
Hs Hypochondriasis	16	4.00	2.47	16	3.75	3.13	+ .24	
D Depression	16	21.12	5.35	16	19.93	3.60	+ .72	
Hy Hysteria	16	20.94	3.83	16	19.75	3.51	+ .89	
Pd Psychopathic Deviate	16	14.13	5.01	16	15.50	6.33	− .66	
Mf Interest	16	38.69	3.77	16	37.25	3.83	+ 1.04	
Pa Paranoia	16	9.12	3.28	16	9.00	3.46	+ .10	
Pt Psychasthenia	16	13.19	6.77	16	13.69	7.67	− .19	
Sc Schizophrenia	16	9.81	5.45	16	11.25	10.06	+ .49	
Ma Hypomania	16	13.94	3.77	16	16.06	4.52	− 1.39	

TABLE 12a

INTERCORRELATIONS BETWEEN WP SPELLING AND THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY FOR 42 UNIVERSITY MEN

(Sample III)

Variable	Sp.	K	F	Hs	D	Hy	Pd	Mf	Pa	Pt	Sc	Ma
WP Sp	....	−.04	.00	.05	−.03	.02	.00	.02	.22	−.10	−.09	−.12
K		....	−.13	−.09	−.24	.30	−.13	−.00	.24	−.34	−.24	−.14
F			....	.29	.68	.06	.55	.49	.29	.68	.82	.37
Hs				....	.22	.67	.09	.13	.29	.43	.36	.10
D					....	.10	.50	.37	.25	.61	.56	.06
Hy						....	.05	.19	.49	.18	.14	.11
Pd							....	.36	.15	.58	.66	.52
Mf								....	.47	.36	.38	.21
Pa									....	.17	.25	.02
Pt										....	.87	.56
Sc											....	.60
Ma												....
Mean	89.3	14.8	4.2	4.1	19.8	21.6	14.1	27.6	9.5	9.8	9.4	15.3
S.D.	7.7	7.2	3.2	4.1	4.8	4.5	3.6	5.1	2.7	7.6	7.3	4.3

TABLE 12b

INTERCORRELATIONS BETWEEN WP SPELLING AND THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY FOR 59 UNIVERSITY WOMEN

Variable	Sp.	K	F	Hs	D	Hy	Pd	Mf	Pa	Pt	Sc	Ma
WP Sp	....	−.03	−.06	.14	.14	.19	−.12	.14	−.01	−.03	−.08	−.14
K		....	−.28	−.40	−.43	−.04	−.37	.07	−.05	−.54	−.50	−.26
F			....	.35	.34	.18	.67	.01	.27	.54	.71	.56
Hs				....	.61	.36	.24	.07	.28	.70	.62	.14
D					....	.46	.32	.12	.32	.86	.74	−.05
Hy						....	.12	.02	.45	.26	.14	−.03
Pd							....	−.10	.27	.55	.73	.63
Mf								....	.08	.18	.06	.05
Pa									....	.42	.40	.10
Pt										....	.84	.33
Sc											....	.55
Ma												....
Mean	89.2	15.1	3.0	4.0	20.6	20.9	14.3	38.2	9.5	12.5	10.0	15.8
S.D.	7.4	5.6	2.8	3.2	4.9	3.6	5.1	4.6	3.0	7.7	8.0	4.5

TABLE 12c

INTERCORRELATIONS BETWEEN WP SPELLING AND THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY FOR 101 UNIVERSITY STUDENTS

Variable	Sp.	K	F	Hs	D	Hy	Pd	Mf	Pa	Pt	Sc	Ma
WP Sp	....	−.04	−.04	.10	.07	.11	−.08	.06	.08	.06	−.09	−.13
K		....	−.21	−.22	−.33	.14	−.26	.04	.08	−.43	−.37	−.20
F			....	.32	.46	.13	.59	.02	.27	.55	.73	.45
Hs				....	.42	.52	.18	.06	.28	.56	.49	.12
D					....	.28	.38	.21	.30	.66	.52	.00
Hy						....	.09	.00	.46	.20	.13	.03
Pd							....	.06	.23	.55	.70	.59
Mf								....	.16	.30	.16	.12
Pa									....	.32	.34	.07
Pt										....	.84	.43
Sc											....	.57
Ma												....
Mean	89.2	15.0	3.5	4.0	20.2	21.2	14.2	33.8	9.5	11.4	9.8	15.6
S.D.	7.5	6.3	3.0	3.6	4.9	4.0	4.5	7.1	2.9	7.8	7.7	4.4

Sample III, Minnesota Multiphasic Personality Inventory

Table 11 compares the mean subtest scores for the best and worst spellers taking the clinical scales of the MMPI. The t-ratios of the difference between the means indicate that for the men Paranoia separates these two groups at better than the 10 per cent level of confidence.

The t-ratios for women indicate that none bears a significant relationship to spelling ability.

Tables 12*a*, 12*b*, and 12*c* present the intercorrelations for the 42 men, 59 women, and the total group of 101 students in sample III. The means and standard deviations are given at the bottom of each matrix. It should be noted that in this sample the WP Spelling criterion was used. A comparison of the zero-order r's between WP Spelling and the eleven subtests of the MMPI reveals that the highest correlation for men is between spelling and Paranoia (r = .22); for women the highest is between spelling and Hysteria (r = .19). Since not one of the criterion zero-order r's is significant at the 5 per cent level, it remains a matter of speculation as to the value of submitting each of the matrices to further analysis. However, since the MMPI is also used with sample IV, it was deemed advisable to make the multiple correlation analysis of these three subsamples in order to facilitate comparisons with results

TABLE 13

Increase in the Multiple $\overline{R}$ Predicting Spelling Ability as Each New Selected Personality Variable is Added
(Sample III—WP Spelling)

Variable	Zero-order r	Cumulative $\overline{R}$	Contribution to variance[a] (per cent)	Total per cent
A. MEN (N = 42)				
Pa Paranoia	+.22	.16	5.0	5.0
B. WOMEN (N = 59)				
Hy Hysteria	+.19	.14	4.2	
Pd Psychopathic Deviate	−.12	.16	1.8	6.0
C. TOTAL (N = 101)				
Ma Hypomania	−.13	.08	2.4	
Pt Psychasthenia	+.06	.12	.8	3.2

[a] In final set for Sample III only.

in sample IV, and to give the most promising items therein a chance to show themselves in a later analysis.

Table 13 gives the increase in the multiple $\bar{R}$'s as each new test is selected and added to those already selected. The appropriate zero-order r's are given alongside the multiple $\bar{R}$'s for ready comparisons. In the same table, both the total and independent contributions which the selected variables make to the variance of WP Spelling ability are given. For men, Paranoia is the only personality variable from the clinical scales that makes an independent contribution to the variance of WP Spelling ability. For women, Psychopathic Deviate adds 1.8 to the 4.2 per cent of the variance of WP Spelling already accounted for by Hysteria. Hypomania and Psychasthenia together contribute 3.2 per cent to the variance of WP Spelling for the combined sample of 101 students.

Analysis of sample III, then, adds Paranoia, Hysteria, Psychopathic Deviate, Hypomania, and Psychasthenia to our composite battery.

Sample IV_1, Minnesota Multiphasic Personality Inventory

Tables 14*a* and 14*b* compare the mean subtest scores for the best and worst MC Spellers in sample IV_1. For men, the t-ratios indicate a significant difference in the mean scores of the best and worst spellers on the Masculinity-Femininity interest scale at slightly better than the 10 per cent level of confidence. For women, the t-ratios indicate a significant difference in the mean scores of the best and worst spellers in the Psychopathic Deviate and Paranoia areas at slightly better than the 5 per cent level. For both men and women, of course,[8] the scale assessing Linguistic Intelligence (ACE) separates the best from the worst spellers at better than the 5 per cent level of confidence. This latter scale will be used in a very special way in succeeding analyses. Although this is a study on the relation of spelling ability to personality factors, a priori, because personality and spelling ability are both apt to be related to intelligence, the ACE was also used. By this means, a reduced but more truly independent contribution to the variance of spelling ability made by the personality scales can be estimated.

Tables 15*a* and 15*b* present the intercorrelations for the 43 men and 51 women in sample IV_1. Means and standard deviations are given also. Criterion zero-order r's in table 15*a* indicate that for men statistically significant relationships with MC Spelling ability are established at the 5 per cent level for the personality scales Psychopathic Deviate, Depression, and Masculinity-Femininity. Likewise, table 15*b* indicates that

[8] See Phelan (26) and Holmes (15); in these studies intelligence accounted for 39.2 and 13.5 per cent, respectively, of the variance in spelling ability.

TABLE 14a

COMPARISON OF MEAN PERSONALITY SUBTEST SCORES ON THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY FOR BEST AND WORST SPELLERS: 43 UNIVERSITY MEN

(Sample IV_1)

Variable	Best spellers			Worst spellers			*t*-ratio of difference between means	P value (df 11)
	N	Mean	Standard deviation	*N*	Mean	Standard deviation		
MC Spelling (Criterion)	12	47.58	1.44	12	31.83	4.43	+11.21	<.001
WP Spelling	12	74.83	2.12	12	58.33	8.36	+ 6.35	<.001
K Persona	12	15.75	4.84	12	17.75	4.22	− 1.03	
F Scale	12	5.33	4.33	12	3.75	2.55	+ 1.05	
Hs Hypochondriasis	12	3.08	4.31	12	3.42	1.80	− .24	
D Depression	12	19.67	4.87	12	16.58	3.15	+ 1.76	
Hy Hysteria	12	20.58	5.05	12	20.08	3.48	+ .27	
Pd Psychopathic Dev	12	17.00	6.20	12	13.83	2.74	+ 1.55	
Mf Interest	12	30.92	6.14	12	27.00	2.97	+ 1.90	<.10
Pa Paranoia	12	10.25	1.78	12	9.17	2.52	+ 1.17	
Pt Psychasthenia	12	11.25	7.98	12	7.75	5.98	+ 1.16	
Sc Schizophrenia	12	11.50	7.36	12	7.67	5.04	+ 1.42	
Ma Hypomania	12	16.67	4.48	12	17.42	4.19	− .40	
Ac Achievement	12	17.08	2.93	12	15.75	3.08	+ 1.04	
Do Dominance	12	19.25	2.58	12	17.58	3.03	+ 1.38	
St Social Status	12	24.33	2.78	12	23.42	2.78	+ .76	
Pr Prejudice	12	6.58	4.68	12	7.92	4.09	− .71	
IF Intell. Funct	12	49.42	4.17	12	48.00	8.25	+ .50	
Sp Social Part	12	23.33	3.04	12	24.25	3.08	− .71	
Ds Dissimulation	12	9.67	6.87	12	7.83	4.18	+ .76	
Si Social Introv	12	26.08	8.16	12	22.33	5.96	+ 1.23	
Re Responsibility	12	22.92	3.20	12	22.92	4.25	.00	
L Intelligence	12	95.83	15.26	12	70.42	14.75	+ 4.00	<.01

TABLE 14b

COMPARISON OF MEAN PERSONALITY SUBTEST SCORES ON THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY FOR BEST AND WORST SPELLERS: 51 UNIVERSITY WOMEN

(Sample IV_1)

Variable	Best spellers			Worst spellers			*t*-ratio of difference between means	P value (df 13)
	N	Mean	Standard deviation	*N*	Mean	Standard deviation		
MC Spelling (Criterion)	14	47.00	1.36	14	33.93	3.95	+11.27	<.001
WP Spelling	14	74.07	3.62	14	62.71	7.30	+ 5.03	<.01
K Persona	14	16.28	4.31	14	16.14	3.59	+ .09	
F Scale	14	3.57	3.18	14	4.78	2.70	− 1.04	
Hs Hypochondriasis	14	5.00	2.70	14	3.71	2.05	+ 1.37	
D Depression	14	22.57	5.25	14	20.57	6.45	+ .86	
Hy Hysteria	14	20.93	4.03	14	19.71	4.11	+ .76	
Pd Psychopathic Dev	14	16.43	3.70	14	13.14	3.82	+ 2.22	<.05
Mf Interest	14	39.43	5.28	14	37.21	4.46	+ 1.16	
Pa Paranoia	14	10.93	2.71	14	8.78	2.24	+ 2.21	<.05
Pt Psychasthenia	14	12.78	8.84	14	10.71	3.08	+ .78	
Sc Schizophrenia	14	11.36	10.27	14	8.71	3.43	+ .88	
Ma Hypomania	14	13.86	4.07	14	16.57	5.11	− 1.50	
Ac Achievement	14	18.86	2.72	14	17.36	2.22	+ 1.55	
Do Dominance	14	17.43	3.73	14	17.64	2.41	− .17	
St Social Status	14	21.78	3.85	14	23.21	3.20	− 1.03	
Pr Prejudice	14	7.43	4.19	14	8.00	3.38	− .38	
IF Intell. Funct	14	47.57	4.75	14	45.64	3.31	+ 1.18	
Sp Social Part	14	22.43	3.85	14	20.71	4.40	+ 1.06	
Ds Dissimulation	14	10.29	6.33	14	7.78	3.93	+ 1.21	
Si Social Intro	14	30.28	8.63	14	25.64	8.34	+ 1.39	
Re Responsibility	14	23.71	3.58	14	22.14	2.67	+ 1.27	
L Intelligence	14	88.07	20.60	14	70.64	14.35	+ 2.50	<.05

TABLE 15a

INTERCORRELATIONS BETWEEN MC SPELLING AND THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY FOR 43 UNIVERSITY MEN

(Sample IV_1)

Variable	Sp.	K	F	Hs	D	Hy	Pd	Mf	Pa	Pt	Sc	Ma	L (Ace)
MC Sp.	....	−.19	.22	.01	.36	−.04	.37	.33	.24	.28	.26	.04	.50
K		....	−.41	−.32	−.27	.44	−.34	−.17	−.08	−.80	−.62	−.50	−.19
F			....	.56	.64	.24	.73	.34	.06	.60	.79	.43	.08
Hs				....	.50	.36	.47	.37	.18	.53	.63	.43	.09
D					....	.28	.49	.30	.21	.58	.63	.09	.04
Hy						....	.40	.29	.10	−.14	.18	−.07	−.07
Pd							....	.45	.31	.51	.72	.38	.18
Mf								....	.53	.37	.47	.22	.16
Pa									....	.31	.31	.02	.05
Pt										....	.84	.49	.00
Sc											....	.44	.10
Ma												....	.05
L (ACE)													....
Mean	40.6	16.1	4.3	3.5	18.5	20.2	15.9	28.0	9.6	10.3	9.7	16.7	83.6
S.D.	6.6	4.7	3.3	2.9	3.9	4.0	4.4	5.0	2.7	6.8	7.1	4.1	16.6

TABLE 15b

INTERCORRELATIONS BETWEEN MC SPELLING AND THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY FOR 51 UNIVERSITY WOMEN

Variable	Sp.	K	F	Hs	D	Hy	Pd	Mf	Pa	Pt	Sc	Ma	L (Ace)
MC Sp.	....	.06	−.23	.15	.13	.18	.26	.26	.18	.07	.02	−.20	.52
K		....	−.32	−.26	−.25	.35	−.29	−.04	−.13	−.73	−.62	−.47	−.07
F			....	.36	.53	.20	.44	.29	.54	.49	.61	.19	−.03
Hs				....	.41	.59	.21	.08	.36	.40	.49	.14	.01
D					....	.24	.55	.31	.40	.62	.64	−.02	.15
Hy						....	.03	.29	.28	−.02	.07	.18	.14
Pd							....	.15	.44	.48	.47	.34	.02
Mf								....	.23	.25	.20	−.08	.27
Pa									....	.46	.51	.26	.02
Pt										....	.85	.48	.07
Sc											....	.43	.15
Ma												....	−.22
L (ACE)													....
Mean	41.3	16.2	4.2	5.2	21.0	21.8	15.2	39.2	10.4	12.0	10.3	16.2	78.4
S.D.	5.5	4.3	3.1	3.8	4.8	5.3	4.3	4.7	4.0	6.9	7.3	4.9	16.5

TABLE 16

INCREASE IN THE MULTIPLE $\overline{R}$ PREDICTING SPELLING ABILITY AS EACH NEW SELECTED PERSONALITY VARIABLE IS ADDED
(Sample IV_1—MC Spelling)

Variable	Zero-order r	Cumulative $\overline{R}$	Contribution to variance[c] (per cent)	Total per cent
A. MEN[a] (N = 43)				
Pd Psychopathic Dev.	.37	.34	11.9	
D Depressive	.37	.38	12.9	
Hs Hypochondriasis	.01	.45	−.5	
Mf Interest	.33	.48	8.8	33.1
B. MEN[b] (N = 43)				
L Intelligence	.50	.48	22.7	
D Depressive	.37	.58	14.2	
Hs Hypochondriasis	.01	.62	−.5	
Mf Interest	.33	.65	6.6	
Pd Psychopathic Dev.	.37	.66	7.0	50.0
A′. WOMEN[a] (N = 51)				
Masculinity	.26	.22	9.1	
F Scale	−.23	.37	12.3	
Pd Psychopathic Dev.	.26	.54	11.6	33.0
B′. WOMEN[b] (N = 51)				
L Intelligence	.52	.50	25.9	
Pd Psychopathic Dev.	.26	.55	11.4	
F Scale	−.23	.66	9.6	46.9

[a] Sections A and A′ derived from matrices in which the L (ACE) was not included.
[b] Sections B and B′ derived from matrices in which the L (ACE) were included.
[c] In final set for Sample IV_1 only.

for women the Psychopathic Deviate and the Masculinity-Femininity scales bear a significant relationship to MC Spelling ability at about the 5 per cent level of confidence. For men and for women, the L of the ACE has a coefficient of correlation with spelling that reaches values of .50 and .52, respectively.

Sections *a* and *a′* of table 16 present the increase in the multiple $\bar{R}$'s as each new test is selected and added to those already selected. It should be noted that in this analysis only the clinical scales of the MMPI were

used in the equations for predicting MC Spelling ability. In the second analysis, as illustrated in the *b* and *b′* sections of table 16, the correlation coefficients for Linguistic Intelligence were also included.

For men, when the personality variables only are used, Psychopathic Deviate accounts for 11.9, Depression 12.9, and Masculinity-Femininity (Mf Interest) 8.8 per cent of the variance of MC Spelling ability. Hypochondriasis seems to act as a suppressor variable. Table 16, in section *b*–Men, indicates that when L Intelligence is allowed to function in the calculations, it alone contributes 22.7 per cent to the variance of spelling in this sample. Interestingly enough, Depression comes out next, contributing another 14.2 per cent, and this is followed by contributions of 6.6 per cent by the Mf Interest scale, and 7.0 per cent by the Psychopathic Deviate (Pd scale), to make a total contribution of 50 per cent to the variance of spelling ability. Note again that Hypochondriasis works as a suppressor variable.

For women, when only the personality variables are used, Mf Interest accounts for 9.1, F scale 12.3, and Psychopathic Deviate 11.6 per cent of the variance of spelling. Table 16, section *b′*, Women, indicates that when L Intelligence is allowed to function in the calculations, it alone contributes 25.9 per cent to the variance of spelling. The Wherry-Doolittle method next selects the variable Psychopathic-Deviate, and this is followed by F scale. Altogether the three variables contribute 46.9 per cent to the variance of spelling ability of college women.

Sample IV_2, Minnesota Multiphasic Personality Inventory

Tables 17*a* and 17*b* compare the mean subtest scores for the best and worst WP spellers in sample IV_2. For men, the t-ratios indicate that at the 5 per cent level of confidence Mf Interest and Dominance are related to spelling. At the 10 per cent level, or better, the K Persona, F Scale, Depression, and Psychopathic-Deviate scales are all related significantly to spelling ability in this sample. For women, the t-ratios indicate that at the 10 per cent level or better the Mf Interest and Hypomania scales are the only personality variables that seem to be related to spelling. Both sexes show, at better than the 1 per cent level, a significant difference between the means of best and worst spellers for L Intelligence.

Table 18 presents the intercorrelations of the 94 university students in the total sample IV_2. This matrix gives the coefficients of intercorrelations among twenty MMPI personality scales, the L Intelligence of the ACE, and the two criteria scales, MC Spelling and WP Spelling. Means and standard deviations are also included. Inspection of the criteria zero-order r's indicates that the L Intelligence is correlated with spelling ability and the two respective r's are significant at better

TABLE 17a

COMPARISON OF MEAN PERSONALITY SUBTEST SCORES ON THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY FOR BEST AND WORST SPELLERS: 43 UNIVERSITY MEN

(Sample IV_2)

Variable	Best spellers			Worst spellers			*t*-ratio of difference between means	P value (df 11)
	N	Mean	Standard deviation	*N*	Mean	Standard deviation		
MC Spelling	12	46.25	2.92	12	32.75	5.46	+7.26	<.001
WP Spelling (Criterion)	12	75.17	1.63	12	57.17	7.09	+8.22	<.001
K Persona	12	15.00	4.10	12	18.33	4.09	−1.90	<.10
F Scale	12	5.92	4.09	12	3.17	2.27	+1.95	<.10
Hs Hypochondriasis	12	3.92	4.21	12	3.42	1.85	+ .36	
D Depression	12	20.50	4.89	12	17.08	3.25	+1.93	<.10
Hy Hysteria	12	20.17	5.08	12	21.42	2.72	− .72	
Pd Psychopathic Dev	12	17.42	5.99	12	13.83	2.04	+1.87	<.10
Mf Interest	12	30.17	6.62	12	27.42	3.45	+2.22	<.05
Pa Paranoia	12	9.75	2.52	12	9.50	2.60	+ .23	
Pt Psychasthenia	12	11.50	7.48	12	8.67	6.30	+ .96	
Sc Schizophrenia	12	12.58	10.52	12	7.67	4.41	+1.42	
Ma Hypomania	12	16.50	4.77	12	16.17	1.63	+ .22	
Ac Achievement	12	17.08	2.87	12	17.00	3.37	+ .06	
Do Dominance	12	20.42	1.98	12	18.00	2.87	+2.30	<.05
St Social Status	12	23.83	2.20	12	23.83	3.00	.00	
Pr Prejudice	12	6.75	4.37	12	5.58	3.33	+ .71	
IF Intell. Funct.	12	48.92	3.64	12	49.17	4.62	− .14	
Sp Social Part.	12	23.58	3.04	12	24.42	3.23	− .63	
Ds Dissimulation	12	9.58	6.49	12	7.50	2.69	+ .98	
Si Social Introv.	12	26.75	7.73	12	23.58	9.11	+ .88	
Re Responsibility	12	22.83	3.39	12	23.67	3.63	− .56	
L Intelligence	12	97.58	13.74	12	66.83	12.53	+5.48	<.001

TABLE 17b

COMPARISON OF MEAN PERSONALITY SUBTEST SCORES ON THE MINNESOTA MULTIPHASIC PERSONALITY INVENTORY FOR BEST AND WORST SPELLERS: 51 UNIVERSITY WOMEN

(Sample IV_2)

Variable	Best spellers			Worst spellers			*t*-ratio of difference between means	P value (df 13)
	N	Mean	Standard deviation	*N*	Mean	Standard deviation		
MC Spelling	14	46.00	2.45	14	35.71	5.75	+5.95	<.001
WP Spelling (Criterion)	14	75.93	1.71	14	60.57	5.79	+9.20	<.001
K Persona	14	16.50	4.72	14	15.21	3.89	+ .77	
F Scale	14	3.86	3.11	14	4.79	2.95	− .78	
Hs Hypochondriasis	14	4.43	3.35	14	4.64	2.55	− .18	
D Depression	14	21.64	5.51	14	20.36	4.10	+ .67	
Hy Hysteria	14	20.79	3.74	14	20.07	4.50	+ .44	
Pd Psychopathic Dev	14	16.50	3.41	14	14.64	4.03	+1.27	
Mf Interest	14	40.00	5.11	14	36.71	4.33	+1.77	<.10
Pa Paranoia	14	9.21	3.62	14	9.36	2.34	− .13	
Pt Psychasthenia	14	11.50	3.08	14	11.71	3.28	− .16	
Sc Schizophrenia	14	11.21	10.36	14	9.14	3.29	+ .69	
Ma Hypomania	14	14.21	4.71	14	18.14	5.15	−2.02	<.10
Ac Achievement	14	18.00	3.02	14	17.57	2.22	+ .41	
Do Dominance	14	16.93	3.35	14	17.86	2.83	− .76	
St Social Status	14	23.29	3.10	14	23.29	3.10	.00	
Pr Prejudice	14	7.14	4.35	14	9.21	3.52	−1.34	
IF Intell. Funct.	14	46.93	6.39	14	45.07	3.35	+ .94	
Sp Social Part.	14	22.64	3.25	14	21.79	4.16	+ .58	
Ds Dissimulation	14	9.57	6.77	14	10.79	4.34	− .50	
Si Social Introv.	14	27.86	8.75	14	26.14	7.47	+ .54	
Re Responsibility	14	23.93	3.22	14	21.57	2.50	+1.57	
L Intelligence	14	90.00	11.85	14	66.79	19.54	+4.07	<.01

TABLE 18

INTERCORRELATIONS BETWEEN WP–SPELLING, MC–SPELLING, MMPI, AND THE L ASPECT OF INTELLIGENCE FOR 94 UNIVERSITY STUDENTS

(Sample IV_2)

Variable	Sp.–WP	Sp.–MC	(L) ACE	K	F	Hs	D	Hy	Pd	Mf	Pa	Pt	Sc	Ma	Ac	Do	St	Pr	IF	Sp	Ds	Si	Re
WP Spelling	...	.85	.57	−.10	.00	.06	.22	.06	.19	.27	.06	.16	.16	−.16	.09	.04	−.02	.08	.02	.04	.08	.10	.03
MC Spelling		...	.54	−.07	.00	.10	.24	.09	.31	.24	.20	.18	.14	−.09	.13	.04	.04	−.11	.14	.05	.14	.12	.02
L Intelligence			...	−.10	.00	.00	.09	.06	.13	.05	.04	.03	.13	−.07	.07	.16	.16	−.16	.19	.03	.07	.11	.14
K Persona				...	−.36	−.27	−.24	.38	−.31	−.06	−.11	−.75	−.62	−.48	−.34	.37	.42	−.73	.55	.25	−.61	−.45	.51
F Scale					...	.42	.55	.21	.58	.20	.34	.53	.69	.29	.18	−.17	−.16	.43	−.42	−.17	.60	.38	−.38
Hs Hypochondriasis						...	.47	.53	.28	.30	.32	.46	.54	.22	.30	−.17	−.07	.28	−.33	.04	.58	.20	−.27
D Depression							...	.29	.48	.40	.35	.61	.62	.00	.33	−.33	−.18	.34	−.39	−.28	.49	.56	−.12
Hy Hysteria								...	.16	.31	.24	−.04	.11	−.15	.12	.17	.33	−.26	.19	.24	.14	−.15	.18
Pd Psychopathic									...	.13	.37	.48	.58	.36	.20	−.14	−.07	.35	−.32	.12	.57	.18	.36
Mf Interest										...	.29	.29	.24	−.02	.31	−.01	.06	.06	−.13	−.12	.29	.19	.07
Pa Paranoia											...	.41	.43	.18	.34	−.09	−.04	.04	−.06	.07	.50	.11	−.06
Pt Psychasthenia												...	.84	.47	.53	−.50	−.41	.69	−.61	−.30	.79	.56	−.47
Sc Schizophrenia													...	.43	.42	−.39	−.40	.60	−.53	−.20	.80	.52	−.38
Ma Hypomania														...	.15	−.16	−.15	.56	−.40	.14	.59	−.03	−.53
Ac Academic Achievement															...	−.15	−.05	.26	−.17	.02	.37	.26	−.03
Do Dominance																...	.49	−.50	.52	.49	−.30	−.47	.37
St Social Status																	...	−.45	.49	.57	−.35	−.57	.30
Pr Prejudice																		...	−.70	−.30	.58	.39	−.56
IF Intell. Funct.																			...	.40	−.54	−.40	.54
Sp Social Part.																				...	−.12	−.69	.14
Ds Dissimulation																					...	.38	−.42
Si Social Introv.																						...	−.10
Re Responsibility																							...
Mean	68.6	41.0	80.8	16.2	4.2	4.4	19.9	21.1	15.5	34.0	10.0	11.3	10.0	16.4	17.4	17.8	23.3	7.5	47.3	22.9	9.3	25.4	22.4
S.D.	7.4	6.0	16.8	4.5	3.2	3.5	4.6	4.8	4.3	7.4	3.5	6.9	7.2	4.6	2.8	3.0	3.2	4.3	4.9	3.6	5.9	8.0	3.7

than the 1 per cent level. Of all the personality variables, it is Mf Interest that correlates highest with WP Spelling ability, whereas, with MC Spelling ability, it is the variable Psychopathic-Deviate that correlates highest. In each case, the relationship reaches the 1 per cent level of significance. At the 5 per cent level or better, we may add Depression, Mf Interest, and Paranoia to those which are related to the MC Spelling; and we may add Depression and perhaps Psychopathic-Deviate to those already selected in this sample as being related to the WP Spelling.

TABLE 19

INCREASE IN THE MULTIPLE $\bar{R}$ PREDICTING WP SPELLING AND MC SPELLING ABILITY AS EACH NEW VARIABLE IS ADDED
(Sample IV_2)

Variable	Zero-order r	Cumulative $\bar{R}$	Contribution to variance[a] (per cent)	Total per cent
A. WP SPELLING (N = 94)				
MC Spelling	+.85	.84	73.6	
Pr Prejudice	+.08	.86	1.6	75.2
B. MC SPELLING (N = 94)				
L Intelligence	+.54	.53	27.2	
Pd Psychopathic Deviate	+.31	.58	6.9	
Mf Interest	+.24	.60	4.2	38.3

[a] In final set for Sample IV_2 only.

Table 19 shows the increase in the multiple $\bar{R}$'s as each new test is added to those already selected. Since the WP Spelling test represents, perhaps, the best estimate of a student's actual ability to spell a word, it is used as the criterion in the first analysis.[9] In this analysis the interrelationships between the two spelling criteria are also utilized in the multiple $\bar{R}$ calculations. With the WP Spelling as the criterion, then, the Wherry-Doolittle analysis precipitates MC Spelling out of the matrix as the first and most important variable in explaining the variance in WP Spelling. Further analysis precipitates Prejudice as the only personality variable which makes an independent contribution to WP Spelling over and above that contributed by MC Spelling.

Since MC Spelling contributes 73.6 per cent to the variance of WP

[9] That is, the WP spelling test is more functional than either the usual dictation–write-in type of spelling test, or even a multiple-choice type. However, the WP spelling test is much more time-consuming, both to administer and to correct.

Spelling, the next question is what personality factors make a contribution to MC Spelling? In order to answer this, a substrata-factor analysis (13, 15) was made using MC Spelling as the criterion. Reference to section *b* of table 19 reveals the increase in the multiple R as each new test makes its contribution. Note that the L Intelligence registers as making an independent contribution of 27.2 per cent in the variance of MC Spelling ability. Further analysis precipitated Psychopathic-Deviate and Mf Interest as the two personality variables which make an independent contribution to MC Spelling ability over and above that contributed by L Intelligence. Figure 2 presents a flow chart indicating the substrata organization of variables precipitated from the matrix in table 18 as making independent contributions to MC and WP Spelling abilities.

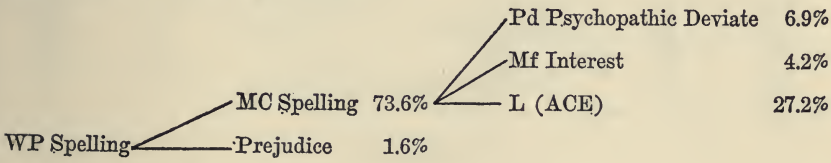

Fig. 2. Flow sheet diagrammatically presenting the organization of the variables underlying MC and WP Spelling abilities in sample IV_2 in per cent.

Summary of Results from Samples I, II, III, and IV

Tables 20*a*, 20*b*, and 20*c* present summaries of the subtests which made independent contributions toward the variance in spelling ability of the men, women, and also of the totals in the first four samples. *Inspection of these summaries will readily indicate that a high spurious overlap would result if the contributions which all these personality variables make toward spelling ability for the sexes separately or together were to be summed.* This comes about through several sources: (a) the unreliability of the separate subtests, (b) error due to small or biased samples, (c) the actual area overlap of discretely named subtests, and (d) the actual use of a score on a single item to count toward the total score on several subscales (i.e., the multiple subscale use of single items). In order to reduce to a minimum the errors of the types mentioned, a new composite battery was constructed by first pooling the subtests reported in tables 20*a*, *b*, and *c*; and then by eliminating item overlap by making an item count for one subtest only. This last effort at an item purification[10] of the tests was directed mainly toward the

[10] The rationale for "purification" arises from the fact that the multiple use of the same items in several subtests could, under certain conditions, spuriously tend to raise a multiple correlation.

TABLE 20a

SUMMARY OF RESULTS FROM SAMPLES I, II, III, AND IV
(Men)

From sample	From table	Variable	Zero-order r	Contribution to spelling variance (per cent)	Spelling criterion
I	7	Analytical Thinking....	+.22	5.7	MC
I	7	Confidence.....	−.14	2.7	MC
II	10	Nervous.....	+.33	13.2	MC
II	10	Self-Mastery.....	+.14	8.2	MC
II	10	Critical.....	+.24	10.4	MC
III	13	Paranoia.....	+.22	5.0	WP
IV_1	16	Psychopathic Deviate..	+.37	11.9	MC
IV_1	16	Depression.....	+.37	12.9	MC
IV_1	16	Hypochondriasis.....	+.01	−.5	MC
IV_1	16	Mf Interest.....	+.33	8.8	MC
IV_1	16	L Intelligence.....	+.50	22.7	MC

TABLE 20b

SUMMARY OF RESULTS FROM SAMPLES I, II, III, AND IV
(Women)

From sample	From table	Variable	Zero-order r	Contribution to spelling variance (per cent)	Spelling criterion
I	7	Analytical Thinking....	+.16	2.4	MC
II	10	Active.....	+.20	2.4	MC
II	10	Critical.....	+.17	5.8	MC
II	10	Nervous.....	−.15	4.2	MC
III	13	Hysteria.....	+.19	4.2	WP
III	13	Psychopathic Deviate..	−.12	1.8	WP
IV_1	16	Mf Interest.....	+.26	9.1	MC
IV_1	16	F Scale.....	−.23	12.3	MC
IV_1	16	L Intelligence.....	+.52	25.9	MC

MMPI, where one item may be used in as many as eight subtests (8). For an item in question, the subtest having the highest correlation with the criterion determined into what subtest it should be placed, and this automatically eliminated that item from any of the other subtests in which it was originally included by the test makers.

The Composite Battery contained the MC Spelling criterion test; the L Intelligence of the ACE test; the Analytical Thinking and Confidence of the HPAI; the Nervous, Active, Critical, and Self-Mastery of the JTA; and the "purified" F Scale, Depression, Hysteria, Psychopathic-

TABLE 20c

SUMMARY OF RESULTS FROM SAMPLES I, II, III, AND IV (Total)

From sample	From table	Variable	Zero-order r	Contribution to spelling variance (per cent)	Spelling criterion
I	7	Analytical Thinking....	+.19	3.9	MC
I	7	Confidence.....	−.04	.4	MC
II	10	Critical.....	+.15	2.9	MC
II	10	Sympathy.....	+.08	1.2	MC
II	10	Aggressive.....	+.10	1.1	MC
III	13	Hypomania.....	−.13	2.4	WP
III	13	Psychasthenia.....	+.06	.8	WP
IV_T[a]	19	MC Spelling.....	+.85	73.6	WP
IV_T	19	Prejudice.....	+.08	1.6	WP
IV_T	19	L Intelligence.....	+.54	27.2	MC
IV_T	19	Psychopathic Deviate..	+.31	6.9	MC
IV_T	19	Mf Interest.....	+.24	4.2	MC

[a] Total.

TABLE 21

PER CENT CONTRIBUTIONS TO THE VARIANCE OF SPELLING AND RELIABILITIES OF THE SUBSCALES ELIMINATED FROM THE COMPOSITE BATTERY

Variable	Contribution to spelling (in per cent)	Reliability
Paranoia.....	5.0	.17
Sympathy.....	1.2	.12
Aggressive.....	1.1	.38
Psychasthenia.....	.8	.86
Prejudice.....	1.6	.56
Hypochondriasis.....	−.5	.28
Hysteria.....	4.2	.44

Deviate, and Hypomania from the MMPI. In the spring of 1954, this Composite Battery was given to a new sample of university students enrolled in similar classes to those from which the original samples were drawn.

It will be observed that some of the variables listed in table 20 are not included in the Composite Battery. Table 21 shows that all contributions which these deleted independent variables made to spelling ability were minuscule and/or all the reliabilities, except perhaps Psychasthenia, are also much too low to trust even for group relationships.

Sample V, Composite Battery

Tables 22*a*, 22*b*, and 22*c* present the intercorrelations for the 62 men, 134 women, and the total sample of 196 students in sample V. The means and standard deviations are also offered. For men, a comparison of the criterion zero-order r's indicates that of the 14 independent variables only one, Confidence, is significantly correlated with MC Spelling ability at the 5 per cent level, and negatively so for the r = –.24. The L Intelligence and the Mf Interest scales approach this level of confidence with spelling r's of .23 and .20, respectively.

For women, a comparison of the criterion zero-order r's indicates that of the 14 independent variables only two, L Intelligence and Analytical Thinking, are significantly correlated with MC Spelling ability at the 5 per cent level or better.

For the total sample, a comparison of the criterion zero-order r's in table 22*c* indicates that of the 14 independent variables only three, L Intelligence, Mf Interest, and Analytical Thinking, are significantly correlated with MC Spelling ability at the 5 per cent level or better.

The severe reduction in the number of independent variables which are now found to be significantly related to spelling ability points a prudent finger at the tremendous instability of personality subtests. Here we see apparently significant relationships found in the first four samples simply wiped away when cross validated in a new sample of students drawn from the same universe (see table 25) as the original samples. This is a warning of how easy it is to be led astray by small "one shot" studies relating personality factors to complex criteria.

As has been indicated earlier, although many of the independent variables do not in and of themselves make statistically significant zero-order correlations with the criterion, it is nevertheless possible for some combination of them to make an independent contribution to the variance of spelling which can be detected by submitting the entire correlation matrix to the Wherry-Doolittle Multiple Correlation Test Selection Method. This being the intent and design of this study, let us proceed to the results of such calculations.

Section *a* of table 23 reveals that for the men the better spellers tend to be less confident, in general, and to have higher scores on the linguistic type of intelligence tests. Four points of interest stand out from this analysis: (a) the fact that whereas Lack of Confidence contributes 9.2 per cent to the variance of spelling, no other personality trait makes a significant contribution; (b) that whereas Mf Interest had the third highest zero-order r with the criterion, it dropped out in the analysis because the "apparent" independent contribution which

TABLE 22a

INTERCORRELATIONS BETWEEN MC SPELLING AND THE COMPOSITE BATTERY FOR 62 UNIVERSITY MEN
(Sample V)

Variable	Sp.	L	A	C	H	I	A	C	F	D	Hy	Pd	Mf	Ma	Lie
MC Spelling	...	.23	.08	.08	.18	−.01	.10	−.24	.17	.05	−.07	.17	.20	.07	−.04
L Intelligence		...	−.02	.06	.05	−.19	.20	−.04	.06	−.02	.06	.10	.28	−.09	.06
A Nervous			...	−.28	.63	−.50	−.23	−.75	.46	.63	.27	.52	.56	.13	−.09
C Active				...	−.08	.23	.09	.27	−.28	−.20	.11	−.09	−.16	−.03	.19
H Critical					...	−.54	−.06	−.65	.59	.59	.39	.59	.58	.32	−.22
I Self-Mastery						...	.09	.59	−.59	−.48	−.23	−.49	−.40	−.30	.31
A Analytical Thinking							...	.19	.04	−.27	−.07	−.09	.09	.06	−.01
C Confidence								...	−.58	−.68	−.29	−.54	−.50	−.18	.16
F Scale									...	.56	.21	.60	.65	.42	−.20
D Depression										...	.62	.64	.54	−.03	.06
Hy Hysteria											...	.43	.36	−.10	.17
Pd Psychopathic Deviate												...	.58	.46	−.20
Mf Interest													...	.24	−.13
Ma Hypomania														...	−.42
Lie (MMPI)															...
Mean	40.0	52.7	4.4	10.2	6.3	13.3	26.3	28.2	4.9	19.5	21.5	14.2	24.9	16.8	3.4
S.D.	5.8	11.9	3.2	3.0	4.3	4.4	5.8	10.0	3.2	5.5	4.5	4.2	5.6	4.2	2.2

TABLE 22b

INTERCORRELATIONS BETWEEN MC SPELLING AND THE COMPOSITE BATTERY FOR 134 UNIVERSITY WOMEN
(Sample V)

Variable	Sp.	L	A	C	H	I	A	C	F	D	Hy	Pd	Mf	Ma	Lie
MC Spelling	...	.48	−.05	−.02	.02	.04	.17	.02	−.14	−.06	.01	.12	.06	−.10	−.02
L Intelligence		...	−.07	.03	.18	−.11	.25	.07	−.05	−.12	−.05	.11	.09	−.09	−.23
A Nervous			...	−.15	.39	−.40	.07	−.54	.33	.45	.18	.40	.33	.14	−.14
C Active				...	−.09	.07	.26	.36	−.22	−.44	.21	.20	−.06	.31	.09
H Critical					...	−.43	.01	−.48	.35	.25	−.29	.19	.05	.11	−.33
I Self-Mastery						...	.09	.46	−.24	−.23	−.10	−.36	−.04	−.32	.24
A Analytical Thinking							...	.00	.09	−.02	−.02	.26	.04	.11	.10
C Confidence								...	−.43	−.53	.13	−.18	−.21	−.13	.24
F Scale									...	.42	−.02	.32	.07	.16	−.05
D Depression										...	.20	.18	.16	−.06	.03
Hy Hysteria											...	.29	.08	.14	.20
Pd Psychopathic Deviate												...	.15	.50	−.11
Mf Interest													...	.12	−.14
Ma Hypomania														...	−.02
Lie (MMPI)															...
Mean	40.3	50.0	5.2	10.4	4.9	13.3	25.6	27.9	3.4	19.1	22.1	12.7	34.9	16.2	3.9
S.D.	4.8	9.4	2.6	2.9	3.1	3.6	6.2	7.2	2.7	4.4	3.9	3.1	4.1	3.9	2.0

TABLE 22c

INTERCORRELATIONS BETWEEN MC SPELLING AND THE COMPOSITE BATTERY FOR 196 UNIVERSITY STUDENTS
(Total Sample V)

Variable	Sp.	L	A	C	H	I	A	C	F	D	Hy	Pd	Mf	Ma	Lie
MC Spelling	...	.36	.02	.02	.06	.02	.14	−.09	−.04	−.02	−.01	.13	.16	−.04	−.01
L Intelligence		...	−.06	.04	.14	−.14	.24	.02	.03	−.07	−.01	.13	.03	−.08	−.13
A Nervous			...	−.19	.46	−.44	−.04	−.63	.34	.52	.22	.42	.39	.13	−.10
C Active				...	−.09	.13	.21	.00	−.24	−.35	.18	.08	−.05	.19	.13
H Critical					...	−.47	−.01	−.55	.47	.40	−.01	.40	.08	.20	−.30
I Self-Mastery						...	.08	.52	−.36	−.34	−.15	−.41	−.15	−.31	.26
A Analytical Thinking							...	.07	.08	−.10	−.04	.13	.01	.10	.05
C Confidence								...	−.47	−.60	−.05	−.34	−.26	−.15	.20
F Scale									...	.47	.05	.47	.05	.26	−.13
D Depression										...	.36	.38	.20	−.04	.04
Hy Hysteria											...	.33	.18	.05	.19
Pd Psychopathic Deviate												...	.11	.48	−.16
Mf Interest													...	.07	−.01
Ma Hypomania														...	−.17
Lie (MMPI)															...
Mean	40.2	50.9	4.9	10.3	5.3	13.3	25.8	27.9	3.9	19.2	21.9	13.2	31.8	16.4	3.7
S.D.	5.2	10.3	2.8	2.9	3.6	3.8	6.1	8.2	3.0	4.8	4.1	3.6	6.5	4.0	2.1

it happened to make toward spelling had already been incorporated within the variance accounted for by the elements of Confidence and Intelligence; (c) that the total variance in spelling ability accounted for by personality variables in this sample of men students is approximately 9 per cent; and (d) that the suppressor effect exerted by Self-

TABLE 23

INCREASE IN MULTIPLE $\overline{R}$ PREDICTION SPELLING ABILITY FROM TESTS SELECTED FROM THE COMPOSITE BATTERY

(Sample V—MC Spelling)

Variable	Zero-order r	Cumulative $\overline{R}$	Contribution to spelling variance (per cent)	Total per cent
A. MEN (N = 62)				
LC Lack of Confidence[a]	+.24[b]	.21	9.2	
L Intelligence	+.23	.28	5.8	
SM Self-Mastery	−.01	.31	−.2	14.8
B. WOMEN (N = 134)				
L Intelligence	+.48	.48	22.3	
F Scale (attention to detail)	−.14	.48	2.1	
Pd Psychopathic Deviate	+.12	.49	1.5	25.9
C. TOTAL (N = 196)				
L Intelligence	+.36	.35	13.1	
Mf Interest	+.16	.38	2.0	
SM Self-Mastery	+.02	.38	.3	
LC Lack of Confidence[a]	+.09[b]	.40	1.7	
Pd Psychopathic Deviate	+.13	.40	1.9	
F Scale	−.04	.41	.6	19.6

[a] Confidence changed to Lack of Confidence, and
[b] Sign reversed in zero-order r for the sake of clarity.

Mastery results in an increase in the contributions which Lack of Confidence and L Intelligence make to the variance of spelling ability.

Section *b* of table 23 reveals that for women the better spellers tend to demonstrate a greater Linguistic Intelligence, to have a greater tendency toward careful attention to details (high F scale), and also to have a slightly greater tendency toward a higher Psychopathic Deviate score. Of particular interest is the fact that from this analysis the F scale and Psychopathic Deviate scale together contribute only 3.6 per cent to the variance of spelling ability in this sample of university

women. The linguistic intellectual factor is most important and contributes 22.3 per cent to the variance of spelling ability.

Section *c* of table 23 reveals that for the total sample of 196 men and women the better spellers demonstrate a greater Linguistic Intelligence, and that the group demonstrates a slight difference in several personality variables from those who spell less well. For instance, the "adjusted" (6) contributions which the several variables made to spelling ability are:

Variable contributing (to the Variance of) Spelling ability	*(in per cent)*
L Intelligence	13.1
Mf Interest	2.0
Self-Mastery	.3
Lack of Confidence	1.7
Psychopathic Deviate	1.9
F Scale	.6

The personality scales, therefore, approximate for the total sample 6.5 per cent of the variance of MC Spelling ability. This is as we would expect, about midway between what personality contributes to spelling variance for men (9.0 per cent) and for women (3.6 per cent).

Discussion of the Suppressor Variable

Reference to section *a*, table 23, will indicate that for men, the better spellers tend to be less confident in general and to have more L Intelligence. The Self-Mastery variable is included in the table, although it contributes virtually nothing to the variance of spelling. The question is, why?

Self-Mastery, although it correlates only –.01 with spelling, correlates +.59 with Confidence and therefore with these men acts as a suppressor variable (40).

In order to check further the effects of this suppressor variable on spelling, the beta weights were calculated for Confidence and L Intelligence only. When this was done, it was found that the contribution which Lack of Confidence made to spelling dropped from 9.2 to 5.5 per cent, and the contribution which L Intelligence made to spelling dropped from 5.8 to 4.9 per cent. Therefore, it may be seen that by including the suppressor variable, Self-Mastery, the combined variance which Lack of Confidence and L Intelligence make to spelling is increased from 10.4 to 15.0 per cent. This calls for a psychological explanation, and the following rationale is submitted as a plausible hypothesis.

First, Caldwell (4) found that better spellers were more confident and poorer spellers less confident in the specific area of spelling. Second, it has been shown that better men spellers are less confident in general. The relationships found, however, in the second case are small —amounting to 5.8 per cent when taken alone, and 9.2 per cent when the suppressor, Self-Mastery, is also taken into account. Psychologically, the explanation of how Self-Mastery works to suppress (when it is not taken into account in the calculation) the effect of Lack of Confidence on spelling ability might run as follows: The variable Confidence itself is a complex factor which, though as a total test it correlates negatively with spelling ability for these men, actually contains many items[11] which are positively correlated with good spelling ability, items which might be specifically related to confidence in spelling estimates in Caldwell's (4) sense. Self-Mastery is defined as the opposite of Impulsiveness. Self-Mastery, as measured by the JTA, is not correlated with spelling but is related to Confidence. Hence when, in a system of simultaneous equations, we take account of Self-Mastery (which contributes nothing to the variance of spelling), we apparently have also accounted for those items in the Confidence subtest which are not related to or are actually positively related to spelling and thus would, if not accounted for in this way, suppress or mask the over-all negative relationship which the greater proportion of this Confidence scale bears to MC Spelling ability.

In other words, when the minor variance derived from those positive items which function to facilitate spelling is withdrawn from the Confidence subtest, the negative items now have a greater chance to exert a major effect on the variance of spelling. In a sense then, what the suppressor test, Self-Mastery, does is to purify the Confidence scale and allow it to function unrestrained by the items which do not work, or which work in the opposite direction. This can be thought of statistically as a purification by partialing out nonfunctional or antifunctional relationships which tend to dilute the major source of the relationship in the over-all effect. This explanation gains some support from an earlier article on the subject by McNemar (24).

By way of shedding further light on the problem, table 24 presents the zero-order r's, $\bar{R}$'s, beta weights, and per cent contributions to the variance of spelling when the multiple correlation technique is carried out using various combinations of the three variables.

Reference to table 24 will show that though Self-Mastery remains stable in contributing a negative two-tenths of 1 per cent to the variance of spelling throughout the various combinations, its inclusion always

[11] Evident in the item analysis.

TABLE 24

INCREASE IN MULTIPLE $\overline{R}$ PREDICTING SPELLING ABILITY WHEN, BY SELECTIVE ELIMINATION, FUNCTIONING TESTS ARE COMBINED DIFFERENTLY IN ORDER TO STUDY THE VARIOUS EFFECTS OF THE SUPPRESSOR VARIABLE, SELF-MASTERY (Sample VII—Men)

Variable	Zero-order r	Cumulative $\overline{R}$	Beta weights	Contribution to variance (per cent)
Confidence (alone)	−.24	.21	−.24	5.8
Confidence	−.24	.21	−.36	8.6
Self-Mastery	−.01	.22	.20	−.2
Confidence	−.24	.21	−.23	5.5
L Intelligence	+.23	.28	.22	4.9
Confidence	−.24	.21	−.38	9.2
L Intelligence	+.23	.28	.26	5.8
Self-Mastery	−.01	.31	.27	−.2

works to improve the contributions which Confidence, L Intelligence, or Confidence *and* L Intelligence, make to spelling ability.

SAMPLE V, THE FIRST ITEM ANALYSIS: THE COMPOSITE BATTERY

Of the fourteen separate subscales in the Composite Battery administered to sample V, only a few actually stood the test of a cross validation. It will be remembered that in constructing the Composite Battery, the subscales were purified to the extent that items now were allowed to function for only a single subscale—adjudged the "most" appropriate. Since the per cent contribution which the subscales made to the variance of spelling was indeed modest, it was deemed advisable to make an analysis of the 640 items in the Composite Battery in order to select those which were functioning to discriminate between the best and worst spellers.

Therefore, without regard for the clinical scale in which items were originally contained, items which discriminated between the best and worst men and women spellers were selected. The usual chi-square technique was utilized. In order that all items which showed even a modest probability of working to discriminate would be selected in this first item analysis, and perhaps overguarding against the type II error, the very liberal confidence level of $P < .25$ was used. In this way a 50-item scale was constructed for men, a 50-item scale for women, and a 50-item scale for the combined group.

Out of the 640 items which comprised the Composite Battery, 135 items (15 items were common to the two sexes) were thus selected and incorporated into a new spelling-personality scale which was given the title, Psychoscope I, in order not to disclose the purpose of the scale.

Sample VI, The Second Item Analysis: Psychoscope I

The 135-item Psychoscope I, together with the MC Spelling Test, was now administered to a new group of 87 men and 279 women in a new sample VI. Correlations calculated between MC Spelling ability and Psychoscope I for both men and women alike were low, and it was decided that a second item analysis on sample VI was in order. Hence a second item analysis for men and women, separately, was now carried out on the 135 items in order to select items that were consistent in discriminating for a second time the best from the worst spellers in the two sexes. This accomplished, new keys were made for a 50-item spelling-personality subscale for men, and also for a 50-item spelling-personality subscale for women (40 of the items for women, 33 items for men, discriminated at better than the 15 per cent level).

The Psychoscope II answer sheets for the 87 men and 279 women in sample VI were rescored on the basis of these new keys which were derived from the two successive item analyses. The coefficient of correlation between the MC Spelling Test and the new men's spelling-personality subscale was +.61, and the correlation between the MC Spelling Test and the women's new spelling-personality subscale was +.45. It must be remembered that these r's of .61 and .45, expressing the relationship between spelling and these spelling-personality subscales for men and women at the college level, are spuriously high! Of course the reason they are spuriously high is that the correlations were computed on the same groups on which the second item analysis had been made. Consequently, the new keys, referred to as keys for Psychoscope II, must be cross validated on an entirely new sample.

Sample VII, The Validation of Psychoscope II

When the new 50-item scale for men and the 50-item scale for women were constructed for Psychoscope II, it was found that because of item overlap for the two sexes, only 80 items were left.

These 80 items in Psychoscope II were now administered to 138 men and 391 women in a new sample VII drawn from classes similar to those from which the previous samples had been drawn. After scoring the MC Spelling test and the two 50-item scales, correlations were calculated between the variables. It must be reported that the spuriously high correlations found in sample VI simply collapsed in sample VII.

For men the coefficient of correlation dropped from .61 to .12, and this is not significant at even the 5 per cent level of confidence. For women the coefficient of correlation dropped from .45 to .05, and (in spite of the large sample) this figure also is not significant at the 5 per cent level of confidence.

Once again we are confronted with the fact that the stability of a personality item is a tenuous affair. Although there can be no loss in efficiency in the successive sampling technique as applied here to the items accepted for subsequent trials, there is the definite possibility that, because personality items are indeed unstable when selected on the basis of samples of less than 800 cases (5), a few of the potentially "good" items were prematurely discarded. On the other hand, those items which were finally included in Psychoscope II had stood the test of discriminating in the "right" direction through two previous item analyses and had also been included in subtests which had stood up in a cross validation of at least two multiple correlation analyses. Hence, it seemed reasonable to believe that the items assembled in Psychoscope II should have discriminated between best and worst spellers on this new sample. They did not! It is not likely that sample VII is not a representative sample of the population since the means for the spelling test are very close to the means in the previous samples. Table 25 shows a comparison of the means and standard deviations for spelling in the various samples.

It is possible, however, that these items, out of their former context, tend to lose something of their potency for discrimination on the basis of the original criterion.

TABLE 25

COMPARISONS OF THE MEANS AND STANDARD DEVIATIONS FOR THE CRITERION MC SPELLING IN THE SEVEN SAMPLES

Sample	Men			Women		
	N	Mean	S.D.	*N*	Mean	S.D.
I	70	40.3	4.7	113	41.1	4.6
II	43	40.0	6.1	87	41.4	4.1
III[a]	42	....	...	59	....	...
IV	43	40.6	6.6	51	41.3	5.5
V	62	40.0	5.8	134	40.3	4.8
VI	87	39.3	5.6	279	40.8	4.7
VII	138	40.9	6.5	366	41.2	5.4

[a] WP Spelling test was used.

In purifying the Psychoscope scales we have eliminated the directly nonfunctioning items, but perhaps these were the very items that gave the mental-set that made the retained items previously work.

All in all, however, the more parsimonious explanation would be that because personality items are so highly unstable, there is a high probability that an item selected on the basis of a relatively small sample will reverse itself when cross validated on a second sample. If this explanation is accepted, then there remains the possibility that some of the successively selected items in the successive validations are still functioning successfully but that their effect is being masked by unstable ones. If this is true, a third item analysis should reveal those consistently stable items.

On this hypothesis, then, a third item analysis was performed. For the men, 26 of the 50 items either reversed their direction or did not discriminate in the final validation sample! Of the remaining 24 items which continued to discriminate in the right direction, only 17 reached, by the technique of Per cent–Discrimination and Discrimination-Index (22) a level of confidence which would make them acceptable!

Table 26 presents the stable core of items which for the men has differentiated the best from the worst spellers consistently through several multiple correlations and also through three successive item analyses as the number of items was reduced from 1,018 original items to the present 24. Table 26 presents in three columns the average per cent of good and poor men spellers making correct (keyed to high spellers) responses, the Per cent–Discrimination, and the Discrimination-Index (22) for the best and worst spellers on validation sample VII.

Analysis of table 26 reveals that:

1. For college men, the best spellers in general report themselves as being more analytical in their thinking, less confident and less active as doers, more critical, depressed, nervous, and more interested in individual scholarship than the poor spellers.

2. For college men, the worst spellers in general report themselves as being slightly less analytical in their thinking, less critical, more composed, masculine, gregarious, physically active, and seem to be more happy with their life role (except in spelling) than do the best men spellers.

Table 27 presents the stable core of items which have consistently differentiated the best from the worst spellers for women, through several multiple correlations and through three successive item analyses as the number was reduced from 1,018 original to the present 17 items. It should be noted that for the selection of these 17 items 1,114 women

TABLE 26

SPELLING PERSONALITY SCALE FOR MEN: PSYCHOSCOPE III

(Items selected on the bases of three item analyses, and also on two or more subtest analyses. These items show a consistent difference between best and worst spellers.)

Item No.	Keyed to best spellers	Question[a]	Average correct (per cent)	Discrimination	
				Per cent	Index
40	T	I often feel there are really few things worth living for	8	16	1.60
7	T	I have been inspired to a program of life based on duty, which I have since carefully followed	30	16	1.12
16	T	I would rather keep my radio on a symphony than turn to popular music	54	38	1.00
76	T	I brood a great deal	16	16	.70
12	F	I daydream very little	58	24	.62
73	F	I take criticism easily, without resentment	42	24	.62
80	F	My conduct is controlled largely by the customs of those about me	38	22	.58
79	F	I "stand up" well under adversity	14	11	.53
8	T	I used to (or even now) chew pencils or bite my fingernails	41	19	.50
47	F	I am lively enough that someone might refer to me as "always-on-the-go."	56	19	.49
52	F	I have had no difficulty in starting or holding my bowel movements	17	11	.46
63	T	I often pause just to meditate about things in general	65	16	.43
59	T	I am likely not to speak to people until they speak to me	43	16	.42
17	T	I often philosophize concerning the purpose of life	54	16	.41
18	F	I enjoy work that needs very little thought after it is learned	77	14	.41
20	F	I should like to belong to several clubs or lodges	50	14	.36
39	F	I was a slow learner in school	82	8	.31
65	T	I consider myself hard to please	41	11	.29
3	F	My relatives are nearly all in sympathy with me	23	8	.27
9	F	I have a voice that flows evenly and smoothly	46	10	.26
41	T	I do a lot of thinking, more than needed by my work	61	8	.21
31	F	Conversation helps me more than reading in formulating my ideas	34	8	.21
55	T	I have periods of such great restlessness that I cannot sit still long	41	5	.13
58	T	I certainly feel useless at times	49	5	.13

[a] Question form from Psychoscope III. Discrimination per cent and Discrimination Index given are from final-validation Sample VII only.

TABLE 27

SPELLING PERSONALITY SCALE FOR WOMEN: PSYCHOSCOPE III

(Items selected on the bases of three item analyses, and also on two or more subtest analyses. These items show a consistent difference between best and worst women spellers.)

Item No.	Keyed to best spellers	Question[a]	Average correct (per cent)	Discrimination	
				Per cent	Index
39	F	I was a slow learner in school	87	16	.83
24	T	I am relatively calm when others are getting rattled	77	18	.61
19	T	I am against giving money to beggars	35	18	.49
9	T	I have a voice that flows evenly and smoothly	52	17	.43
44	T	I usually try to avoid being made chairman of a committee or an officer of an organization	22	11	.38
30	T	I seem to be about as capable and smart as most others around me	94	4	.34
28	F	When I was a child, I belonged to a crowd or gang that tried to stick together through thick and thin	63	11	.29
68	T	I can work in a room with many others talking and work efficiently without strain	42	11	.28
13	F	I am good at "breaking the ice" in a social gathering	51	11	.28
56	T	I think I would like the work of a librarian	26	8	.25
35	T	I tend to be quick and certain in my actions	23	7	.24
73	F	I take criticism easily without resentment	34	9	.24
79	T	I "stand up" well under adversity	75	6	.19
80	F	My conduct is controlled largely by the customs of those about me	33	7	.19
16	T	I would rather keep my radio on a symphony than turn to popular music	55	7	.17
53	F	I know who is responsible for most of my troubles	46	6	.15
25	F	I often have the blues	76	4	.13

[a] Question form from Psychoscope III. Discrimination per cent and Discrimination Index given are from final-validation Sample VII only.

were tested. The Per cent–Discrimination and the Discrimination-Index for each item are presented.

Analysis of table 27 reveals that:

1. For college women, the best spellers in general report themselves as being more intellectually composed, confident, and critical, but less gregarious than the college women who are the worst spellers.
2. For college women, the worst spellers in general report themselves as being intellectually less confident, more nervous, more tractable, and more interested in gregarious leadership than are the college women who are the best spellers.

IV. SUMMARY AND CONCLUSIONS

The purpose of this study was to discover the relationships, if any, that exist between certain aspects of personality and spelling ability at the college level.

Method of Attack

The Method of Successive Analyses was used:

1. To select, by multivariate cross-validation analyses out of 33 original personality scales, those subtests which were consistent from sample to sample in making significant contributions to the variance of spelling ability.
2. To select, out of an original 1,018 personality items, by item analyzing successive samples, those items which were consistent from sample to sample in differentiating at a significant level of confidence the best from the worst college spellers in both sexes.

Review of Literature

Phelan (26) has shown that rote memory, cognition, and visual perception together account for about 51 per cent of the variance of spelling ability.

Holmes (15) has shown that phonetic associations, linguistic intelligence, tonal memory, and pitch together could account for from 40 to 50 per cent of the variance of spelling ability in high school and college students.

Although this writer has not been able to find a single investigation in the literature relating personality to spelling at the college level, Schonell (32), Russell (29, 30), Spache (34), and Kyte (21) all have suggested that spelling difficulties and emotional difficulties may be related. The present study presents an experimental attack on the problem.

Sample and Experimental Design

1. At least one spelling test and a personality inventory were administered to successive samples drawn from the same general population. The personality scales which made a significant contribution to the variance of spelling in the first four samples were collected into a Composite Battery. This new battery of personality scales, together with a spelling test, were administered to a fifth sample. The correlation matrices were analyzed by the Wherry-Doolittle Test Selection Method in order to select the scales which were consistent in making a significant contribution to the variance of spelling in the cross-validating sample. In all, 1,599 students were used.

2. The Composite Battery given to sample V was item analyzed for discriminating items. New personality scales were constructed. These scales were administered with a spelling test to sample VI. The item analysis procedure was repeated; inconsistent and nonfunctioning items were discarded. New 50-item spelling-personality scales were once again constructed and administered to sample VII. Finally, these already highly selected items were analyzed once again to determine just which ones were consistent in discriminating the best from the worst spellers in both sexes. These constitute the core items for two Spelling-Personality Scales—one for each sex.

The Method of Successive Analysis

Table 28 presents the numbers of the successive samplings which were necessary to establish the "stability" of the subtests and the items. The table also presents the criterion and personality battery used with each successive sample.

TABLE 28

Experimental Design Developed in Carrying Through the Method of Successive Analysis

Successive sample	Males *N*	Females *N*	Criterion	Independent variable (Personality tests)
I	70	113	MC Spelling	Heston
II	43	87	MC Spelling	Johnson
III	42	59	WP Spelling	MMPI—Clinical
IV_1	43	51	MC Spelling	MMPI—Clinical
IV_2	43	51	WP, MC Sp.	MMPI—Clinical + added scales
V	62	134	MC Spelling	*Composite:* Psychoscope I
VI	87	279	MC Spelling	Psychoscope II
VII	138	391	MC Spelling	Psychoscope III

Results: Subtest Analysis, Men

Subtest analyses.—For men, out of thirty-three original personality subtests only ten were left after the first four samples of men had been analyzed. The scales that showed promise of making a significant contribution to the variance of spelling ability at the college level were: Analytical Thinking, Lack of Confidence, Nervous, Self-Mastery, Critical, Paranoia, Psychopathic Deviate, Depressive, Hypochondriasis, and Mf Interest. These were from the six scales of the Heston Personality Adjustment Inventory, the nine scales of the Johnson Temperament Analysis, and the twenty-one scales (including three validating scales) of the Minnesota Multiphasic Personality Inventory.

Successive analysis in the cross-validation sample V reduced these significant scales to just one: Lack of Confidence, with Self-Mastery functioning as a suppressor variable. L Intelligence of the ACE was also consistent in making a contribution to the variance of spelling. The final contributions which each of these successively selected subtests made to spelling are:

Subtest	Per cent contribution to spelling variance	Subtest reliability
Lack of Confidence.....	9.2	.90
L Intelligence	5.8	.91
Self-Mastery.....	−.2	.75

Item analyses.—For men, an item analysis of the 640 items retained in the Composite Battery given to sample V produced three scales (for men, women, and the total) which differentiated best from worst spellers in the "keyed" direction and reduced the number of "functioning" items to 135. The successive item analysis on sample VI reduced this number to 50 for men.

A final cross-validation check on sample VII reduced to 24 the items which were still consistently discriminating the best from the worst men spellers.

If we extract the essence of these 24 items and also are cognizant of the way best and worst spellers consistently answered them through seven samples, we are able to describe tendencies:

1. For college *men,* the best spellers tend to feel, or at least report that they feel, that there are really few things worth living for; they believe that they are dedicated to a life of duty; they prefer symphony to popular music, tend to brood a great deal, daydream, resent criticism,

do not want to be controlled by customs, do not stand up well under adversities, tend to chew pencils and bite their fingernails, do not consider themselves go-getters, experience difficulty with bowel movements, often pause just to meditate about things, are not likely to speak to strangers first, often philosophize concerning the purpose of life, enjoy work that makes them think, dislike the idea of belonging to several clubs, consider themselves fast learners, consider themselves hard to please, do not believe relatives are in sympathy with them, believe their voices do not flow evenly, believe they think more than they need to, prefer reading to conversation as a help in formulating their ideas, admit to periods of great restlessness, and finally say they "certainly feel useless at times."

2. For college *men,* the worst spellers tend to feel, or at least report, that there are really many things worth living for, that they have not dedicated their lives to duty, they like popular music as well as symphony, do not brood nor daydream excessively, take criticism without resentment, are considerate of customs in controlling their conduct, believe they stand up well under adversities, do not chew pencils nor bite fingernails, consider themselves lively and always-on-the-go, have no difficulty in starting and holding bowel movements, do not admit to pausing often just to meditate about things, they are likely to speak to strangers first, say that they do not often philosophize concerning the purpose of life, they enjoy work that has an element of routine, would enjoy belonging to several clubs, consider themselves as having been slow learners in school, do not consider themselves hard to please, believe relatives are in sympathy with them, say their voices flow smoothly, do not admit doing much more thinking than is required by their work, prefer conversation to reading as a way of formulating their ideas, do not admit being overly restless, and indicate that they seldom, if ever, are plagued with the feeling that they are useless.

Results: Subtest Analysis, Women

Subtest analyses.—For women, out of the original thirty-three personality subtests only eight were left after the first four samples of women had been analyzed. These eight scales, which showed promise of making a significant contribution to the variance of spelling ability for women at the college level, were Analytical Thinking, Active, Critical, Nervous, Hysterical, Psychopathic Deviate, Masculinity-Femininity, and the F Scale.

Successive analysis in cross-validation sample V, however, reduced these eight to just two: F Scale and Psychopathic Deviate. L Intelli-

gence of the ACE was also consistent in making a prominent contribution to the variance of spelling.

The final contributions which these successively selected subtests make to spelling are:

Subtest	Per cent contribution to spelling variance	Subtest reliability
L Intelligence.....	22.3	.91
F Scale.....	2.1	...
Psychopathic Deviate.....	1.5	.43

Item analyses.—For women, an item analysis of the 640 items retained in the Composite Battery given to sample V produced a scale which differentiated best from worst spellers in the keyed direction and reduced the number of functioning items for men and women to 135. A successive item analysis on sample VI reduced this number to 50 for the women.

A final successive-sample cross-validation check on sample VII reduced to 16 the items which were still consistently discriminating the best from the worst spellers.

If we extract the essence of these 16 items and at the same time are cognizant of the way the best and worst spellers consistently answered them, through seven samples, we are able to describe the following tendencies:

1. For college *women,* the best spellers tend to consider themselves, or at least report themselves, fast learners in school, not easily rattled, do not believe it right to give money to beggars, believe that their voices flow smoothly, avoid being made chairman, think they are as smart and capable as those around them, did not as children give close allegiance to a gang, feel they can work efficiently although others are talking near them, fancy that they would like the work of a librarian, feel that they stand up well under adversities, prefer symphony to popular music, do not often experience the blues, do not consider themselves good at breaking the ice, profess to resent criticism, and will not admit to allowing their conduct to be controlled by custom.

2. For college *women,* the worst spellers tend to consider themselves, or at least report themselves, as being slow learners in school, admit getting rattled easily, are not against giving money to beggars, feel that their voices do not flow evenly, do not mind being made chairman, believe that the people around them are smarter, say they were

loyal to a gang as children, are easily distracted by talking, do not think they would like the work of a librarian, profess not to stand up well under adversities, like popular music as well as symphony, often have the blues, consider themselves good at breaking the ice, indicate that they take criticism easily and without resentment, and are definitely conscious of custom in placing self-controls on their conduct.

General Conclusions

1. For college men, the personality factor that we might describe as a general Lack of Confidence appears to account for success in spelling to the extent of about 9 per cent of the variance when the suppressor effect of Self-Mastery is also taken into account.

2. For college men, generalizations based upon the item analyses would indicate that the best spellers are not only in general less confident and less social, but tend to be more analytical and critical in their thinking and perhaps as a consequence of this combination of traits tend to be more nervous, worried, and depressed than the worst spellers. Perhaps this is a point for the concept of compensation, for as Caldwell (4) has pointed out, success in spelling is positively related to a specific confidence in ability to spell.

3. For college men, the worst spellers report themselves as having the following personality syndrome: Confidence in social situations, no particular anxiety concerning the philosophical purpose of life, and not particularly threatened by their own ego involvements in competitive situations. They, in contrast to the best men spellers, do not feel any great need to be intellectual, critical, or dedicated, but, rather, they apparently accept life as something to be enjoyed.

4. For college women, only about 3.6 per cent of the variance of spelling success could be ascribed to personality factors. The F scale, which measures consistency of responses or careful attention to detail, appears slightly related. On the other hand, the Psychopathic-Deviate scale appears to draw its relationship to good spelling ability in women from those elements in the test scale that tend to assess the tendency to be individualistic, asocial, and perhaps egocentric; certainly it does *not* draw it from those parts that assess the tendency to be undependable, irresponsible, impulsive, defiant, tactless, improvident, or from the inability to calculate one's own social stimulus value.

5. For college women, generalizations based upon the item analyses would indicate that the best spellers tend to be more intellectually efficient, composed, confident, and critical, but also less gregarious than those college women who are the worst spellers.

6. For college women, the worst spellers are likely to report themselves as having the following personality syndrome: intellectually less confident, slightly more nervous, more tractable, and certainly more interested in gregarious leadership than are the college women who are considered the best spellers.

7. Beyond the problem of the relationship of spelling to personality factors, the single most important finding is the marked instability of personality items when analyzed on samples, the sizes of which are quite adequate when one is dealing with cognitive-type material.

Critical and Theoretical Discussion

Two related and cogently critical questions demand attention: In effect, is it not misleading to report such small contributions to the variance of spelling ability, and to delineate such a small number of items and then to discuss or try to interpret such findings as is done here? And, in effect, are not the final results reported here essentially negative (i.e., could they not have occurred by chance)?

The answers to these questions are not uninvolved. *This is an exploratory study, the first of its kind relating personality to spelling ability at the college level,* and therefore clear-cut results would have been fortuitous indeed. Although the reader certainly must take that responsibility for drawing his own conclusions, it may help to take a look first at several possible interpretations before doing so. It is hoped that by stating the somewhat theoretically conflicting interpretations further research in this area will be stimulated.

What was found vs. *what was expected.*—In the section, Review of the Literature, it was indicated that in the present study we could hardly expect to account for more than approximately 20 per cent of the variance in spelling ability in the covariance of personality factors. Against this very limited possibility, the findings (that for men 9.2 per cent of the variance in spelling ability was accounted for by the single personality trait, lack of confidence; and, for women 3.6 per cent of the variance in spelling ability was accounted for by those elements in the F and Pd scales of the MMPI which assess careful attention to detail, tendency to be individualistic, asocial, and perhaps egocentric) do not appear to this writer to be unimportant or even unreasonably small.

The absolute magnitudes are small as expected, but since they are quantified, any discussion regarding them cannot mislead the reader, but should serve only to increase our understanding of the dynamics involved.

The very meagerness of these findings strikes at the claims of those

who proclaim that the major cause of school failures is the maladjustment of personality factors. The situation is particularly poignant in the case of men. Trends throughout the entire study testify that, for men, success in spelling is more closely related to what standard personality scales would call "maladjustment" rather than "good adjustment"! These trends belie the importance of endeavoring to bring every child into line with some normatively derived concept of good adjustment in order that he may learn the better. Perhaps a reconsideration of what is meant by good adjustment is needed by people concerned with the theory of school learning.

Personality adjustment for what purpose? seems to be the question. If the notion that different personality traits are requisite to the achievement of outstanding success in different areas of learning is correct, then it would be more realistic and informative psychoeducationally to speak of "a spelling-personality trait," "a reading-personality trait," or perhaps an "arithmetic-personality trait" instead of an adjusted or maladjusted personality, per se. If such learning-personality scales were validated, they might prove more useful in the school setting than the clinically derived personality traits now in use. In the present study, for example, the evidence points (but, only points) to the suggestion that in general the so-called more maladjusted men are in fact better adjusted to the task of learning to spell than are the more adjusted and socially confident ones. The core items of the present study furnish, to be sure, only the barest skeleton upon which such a spelling-personality scale might be constructed. Such a task is a research project in itself and could not feasibly be attempted within the scope of the present study which, however, has shown the way. What is needed now, is to multiply the number of appropriate items in the "final" Psychoscope III scale; then, give this new Psychoscope IV scale, together with several types of spelling tests and other personality "marker" scales, to a new cross-validating sample. Finally, by selecting and interviewing the best and worst spellers in this new cross-validation sample, we could verify the tentative conclusions arrived at here.

The role of mobilizers as substrata-factor organizers.—Psychology has not yet come to grips with the problem of understanding the psychoeducational importance of an independent variable which itself makes relatively little or no direct contribution to the variance of a criterion but nevertheless facilitates the functional powers of those independent variables that do make sizable contributions to the criterion's variance.

As was indicated on pages 269–271, the explanation of the suppressor

effect involves a sort of purification or partialing out of the ineffective items in those independent variable scales which make marked contributions to the variance of the criterion, although the suppressor variable itself makes no contribution of its own to the variance of the criterion. A case in point is the suppressant variable Self-Mastery, which when *not* taken into account, had the effect of suppressing or lowering the correlation coefficients obtained between spelling and the Lack of Confidence plus L Intelligence (see table 24).

However, what is presently being hypothesized here, is not such a suppressor phenomenon, but a sort of positive analogue to it. The postulated effect of such nonintellectual factors (as here studied and found to be but slightly related to spelling ability) is that they may act as necessary mobilizers for the substrata skills subsumed in the variance of the criterion. Such a mobilizer, though at this time a hypothetical construct, may nevertheless be defined as a deep-seated value system, the presence of which facilitates the function and organization of those substrata skills underlying a higher, more complex ability by compounding them into a unified pattern and making them ready for active service—the total manifestation of which reveals itself as a higher, more complex ability. In other words, as sort of psychocatalytic mobilizers they act to coalesce or psychosynchromesh the hierarchy of available and pertinent subskills and thus bring them into focus on the problem at hand, be it spelling, reading, writing, arithmetic, or the like.

Mobilizers, as here postulated, are to be differentiated from motivators and interest factors. If mobilizers exist, they must be educable traits themselves and must function ordinarily at a subconscious level. It is suggested that the core items offered in the final analysis of the present study may furnish a significant clue as to the nature of such mobilizers—at least in or for spelling ability. Mobilizers, though educable, must be, for the most part, constitutional in the nature of their bent and in the potential available for training. More related to concept-integration than concept-formation, they must play major roles as fundamental value-systems from whence spring the many and specific attitudes a person holds toward the purpose and worth of life, duty, criticism, customs, adversities, society, intellect, and the self.

An example may make the meaning of such postulated mobilizers clearer. It is here suggested that in order for such subskills as are indicated in figure 1 (i.e., visual perception, rote memory, linguistic intelligence, phonetic associations, kinesthetic factors, tonal memory, tonal movement, pitch, intensity, rhythm, etc.) to be efficiently integrated into what may be manifest as spelling ability, they must be sub-

consciously mobilized in accordance with an individual's deeper philosophical purposes or values.

Acceptability of results in terms of confidence levels.—The statistical hazards involved in the acceptance or rejection of a null hypothesis are in this study confounded by both the experimental design and the nature of the personality items used. At first glance it would seem that the most parsimonious explanation for the excessive loss in the number of items (initially in terms of whole scales, and later as individual elements), that consistently discriminated the best from the worst spellers, rests in the instability of the personality items themselves.

Although this explanation is certainly true for many items, it just may be also true that many of the discarded items are reliable in the sense that they reflect the current state of the organism, but because of the daily flux in the affect by which a person responds to essentially the "same" stimuli, no consistent pattern can emerge for these items in a relatively normal school population. These items, if they are more useful in clinical scales, may derive their usefulness from a tendency of "abnormal" or "clinical" populations to respond to them with a more or less rigid response pattern in spite of the changing moods by which a normal individual meets day-to-day changes in the environment. That is, the clinical reliability of such items may be a function of the "clinically maladjusted" rather than the so-called "normally adjusted" (or classroom) populations.

If this is true, then for a relatively normal population, as was used in the present experiment, those items could not consistently correlate with an academic ability such as spelling because the academic "scores" reflecting this latter ability tend to remain relatively constant over reasonable periods of time. The deeper, more stable levels of the normal personality are apparently just not tapped by most of the items in these widely used "objective" personality inventories. Of the few items that do tap these deeper, more stable levels, of course only a limited number could be expected to bear a relationship to such a specific and limited area of academic learning as spelling ability.

To put it bluntly, a relationship between spelling ability and personality either exists or it does not exist. Evidence from this investigation suggests that it does, but the relationship is slight and, judging from the nature of the personality items finally abstracted, seems to be concentrated in what we would ordinarily consider to be the deep and fundamental value-systems[12] within the individual. The ever-present

[12] As indicated previously, the "core items" of personality tests herein found to be related to spelling tend to reflect specific attitudes which a person holds toward the purpose and worth of life, duty, criticism, customs, adversities, society, intellect, and the self.

anomaly, however, is the fact that, within the complex vicissitudes of specific life situations, much learned behavior with its specifically associated attitudes will seem to deny, or at least to be an exception, to the fundamental value-system generally manifest in one and the same person. To phrase it in other terms, the fluctuating specific behavioral attitudes are tied to the superficial dynamics of the personality and need not be entirely consistent with the more stable philosophical values held by an individual. This could explain then, from such a pool of specific behavioral items as used here, why the attrition rate of the nonconsistent items from sample to sample was so great.

Now it was precisely to allow for this possibility that the experimental design was planned to tolerate in the initial phase of each part of this study what convention would normally consider to be a too liberal level of confidence. In other words, the experimental design deliberately set the confidence intervals initially in the first samples so that there would be practically no possibility of committing a type II error (i.e., that of accepting a null hypothesis when in fact the hypothesis was false), because such an error would have resulted in a premature and permanent loss of the scale or item in question. Consequently, there was initially a very high probability of committing a type I error (i.e., that of rejecting a null hypothesis when in fact the hypothesis was true). For this experiment, the use of successive sampling techniques seemed to be the best policy; this is because an error of type I in an initial sample stood a maximum chance of being caught and corrected in the subsequent samples tested.

Further, by tightening up on the confidence interval admissible as the successive analyses progressed and by utilizing the Wherry-Doolittle Test Selection Method on the cross validation of the subscales, a sensible balance was struck between the possibilities of committing the type II and type I errors in the final over-all results.

Table 29 presents the computational data for deriving the over-all significance of the relationship between the personality scale of Confidence and Spelling Ability scores for men.

The replicability found in this analysis tends to substantiate the conclusion that the small relation found is not a function of chance errors of sampling, but rather *represents a true but similarly small relationship between general lack of confidence and spelling ability in the population of men sampled.* That is, for men the null hypothesis that no relationship exists between Confidence and Spelling ability is rejected at about the 3 per cent level of confidence.[13] Because the zero-order r's

[13] This standard may still be much too rigorous, for as Block (2) has so astutely pointed out, empirically generated probability curves indicate that, for such data as those being dealt with in the present study, the statistically classical model may be "overly conservative by a factor of 3 or 4."

are negative, *it is evident that the conclusion seems justified* that a small but significant relationship has been found between the ability to spell words and a certain lack of general confidence in college men.

A similar analysis for women reveals that the relationships found between spelling ability and the F and Pd scale, though small indeed, still have over-all significances derived from summating over samples III, IV, and V at about the 3 and 6 per cent levels of confidence, respectively. Hence, within these probabilities we are apparently justified in assuming the results could not have occurred by chance.[14]

TABLE 29

COMBINING PROBABILITIES FROM INDEPENDENT TESTS OF SIGNIFICANCE FOR COEFFICIENTS OF CORRELATION BETWEEN CONFIDENCE AND SPELLING ABILITY FOR MEN[a]

Sample	r	N	σ_{r_i}	z_i	p_i	$\log p_i$
I	−.14	70	.120	1.165	.1220	$\bar{1}$.0864
V	−.24	62	.128	1.875	.0304	$\bar{2}$.4829
				$\Sigma \log p_i = \bar{3}.5693$		

Changing to natural logs, we have:

$$-2\Sigma \log_e p_i = (-2.4307)\ (-4.605) = 11.1934$$

Therefore with 4 df., $\chi^2 = 11.1934$ and $P < .05$

[a] See Fisher (6) and Snedecor (33) for theory.

Relating results to the literature.—Although there is no pertinent literature at the college level with which to compare the present findings, it may prove helpful to our understanding to search for consistencies or inconsistencies in the conclusions of this study and those reached by Sanford *et al.* (31).

In finding that the best men spellers tend to answer consistently certain items that describe themselves as being more intellectual, analytical, and critical, yet also more depressed, worried, and nervous than the worst spellers, we would suggest that here we have a personality syndrome somewhat comparable to Sanford's social syndrome of Willing Obedience. As was indicated in the review of the literature, Sanford *et al.* (31) found that for children the social syndrome, Willing Obedience, involves a need to avoid blame and seems to favor a painstaking approach. This need to avoid blame for the children who are the better spellers, therefore, seems to be in some way related to the lack of confidence in college men who are the better spellers.

[14] *Ibid.*

Conversely, the general confidence of the college men who are the poorer spellers seems to parallel the findings of Sanford *et al.* (31) that children who spell poorly tend to manifest the social syndromes of Social Feeling and Good Fellowship.

Likewise, when items that differentiate the best from the worst men spellers are reviewed, we are impressed with the parallel between the tenor of the specifics expressed as a generalization in the expression of the worst spellers "that there are many things worth living for," and the personality constellations designated by Sanford *et al.* as the Sensation Creator and the Sensation Seeker. Although both desire sensory impressions (through excitement, sensuality, bodily sensation) and though "both are subjective, human, and emotional in outlook, it is in the former only that this is carried into intellectual and artistic creativity while the latter take their pleasure directly from the environment" (31, p. 569). It will be recalled that the Sensation Creator syndrome correlated –.06 and the Sensation Seeker syndrome –.54 with spelling.

In these two studies, then, we see a certain parallel in the findings which leads to the hypothesis that the elements in the personality associated with good and poor spelling ability in college men may be also functionally related to an even greater degree to spelling ability in children.

Further, for college women the tendency for the best spellers to be consistent and careful corresponds to the Willing Obedience syndrome, and what is seen in the present study as individualistic and asocial may well be related to what might be thought of as a deficiency of Social Feeling in the study made by Sanford *et al.* (31). Verification of these hypotheses, of course, can come only from longitudinal studies which take into consideration each of the sexes separately.

Limitations

1. The samples were all drawn from university students enrolled in education courses, and the above conclusions cannot be extrapolated beyond these data without risk. The writer sees this risk as being much greater for men than for women.

2. The method of successive analysis, as defined and used here, though efficient in terms of time and cost, leaves something to be desired in terms of precision, especially in regard to the items and subtests discarded in the earlier part of the study.

3. The use of another type of spelling criterion, even at the College level, might very well alter these results.

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